

## Лекция №14

**Филогенез нервной, сердечно-сосудистой,  
пищеварительной, дыхательной и мочеполовой  
систем хордовых**

**1. Рыбы**

**2. Амфибии  
(Земноводные)**

**3. Рептилии  
(Пресмыкающиеся)**

**4. Птицы**

**5. Млекопитающие**

ПРЕДСТАВИТЕЛИ  
КЛАССОВ ПОЗВОНОЧНЫХ



# Эволюция органов у хордовых

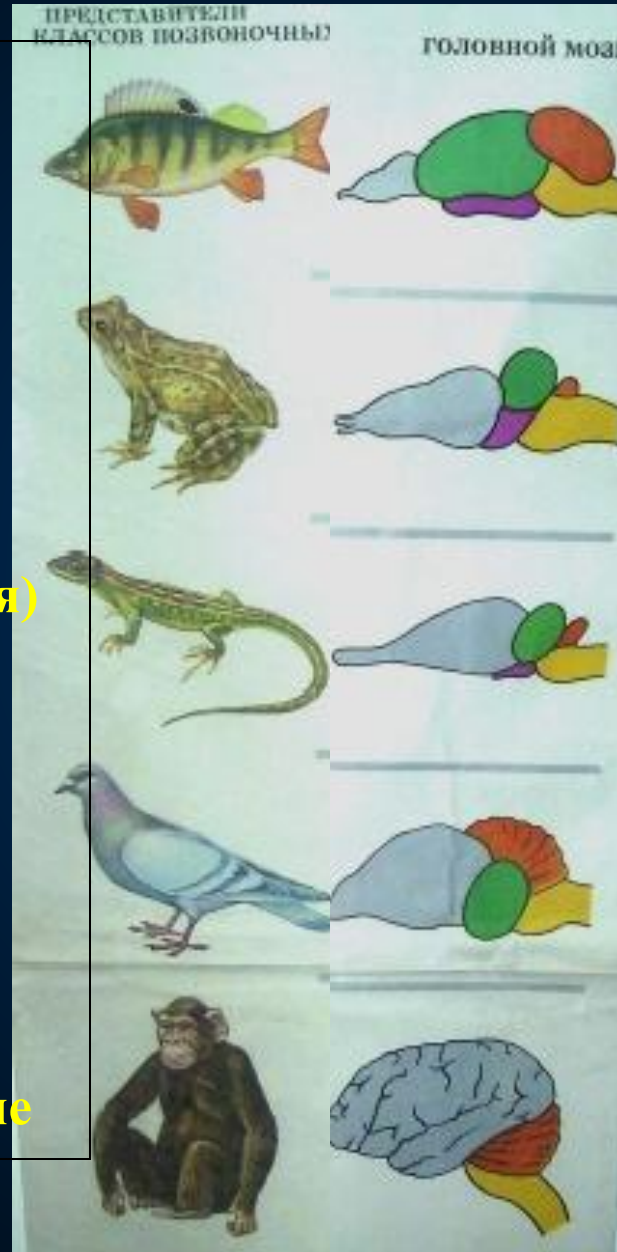
1. Рыбы

2. Амфибии  
(Земноводные)

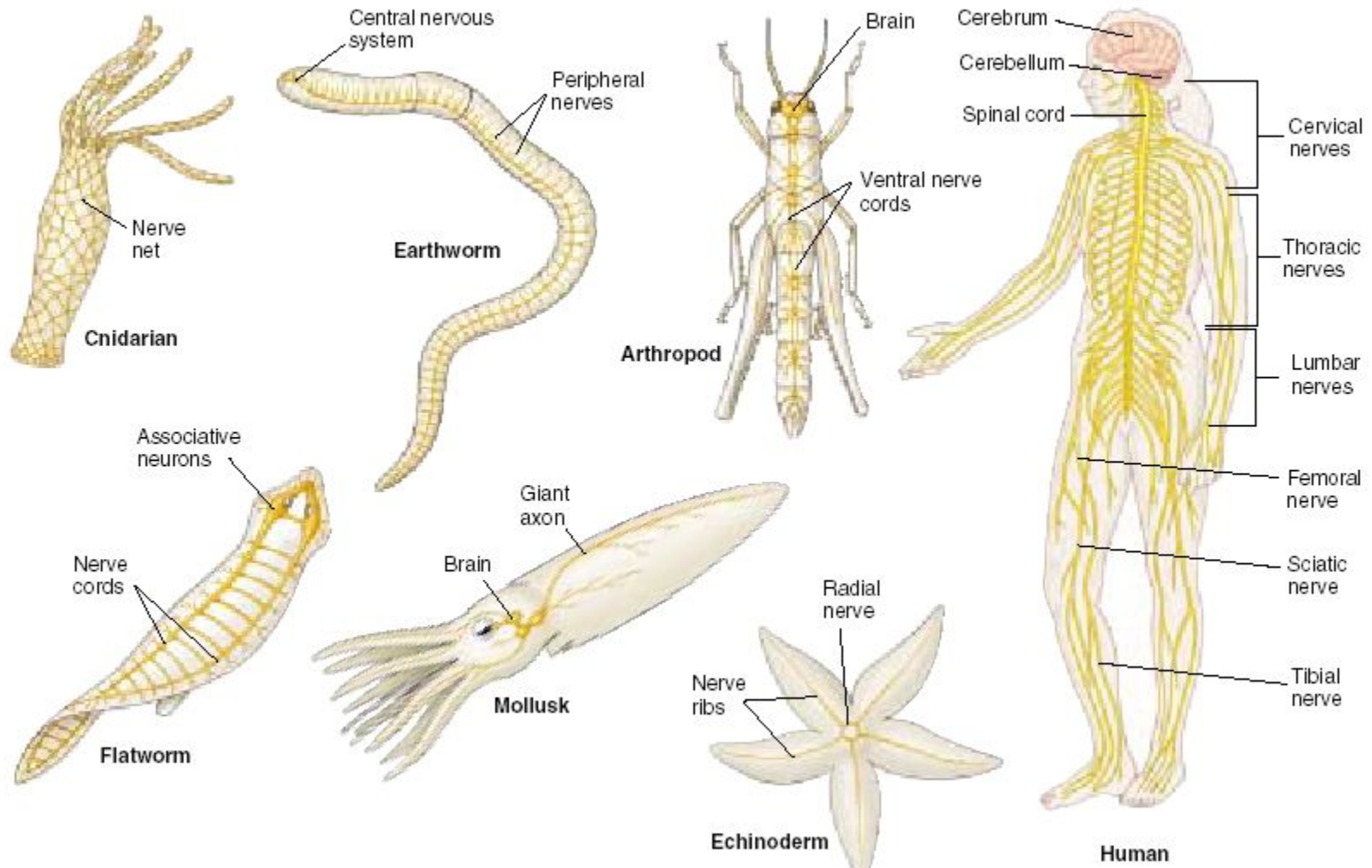
3. Рептилии  
(Пресмыкающиеся)

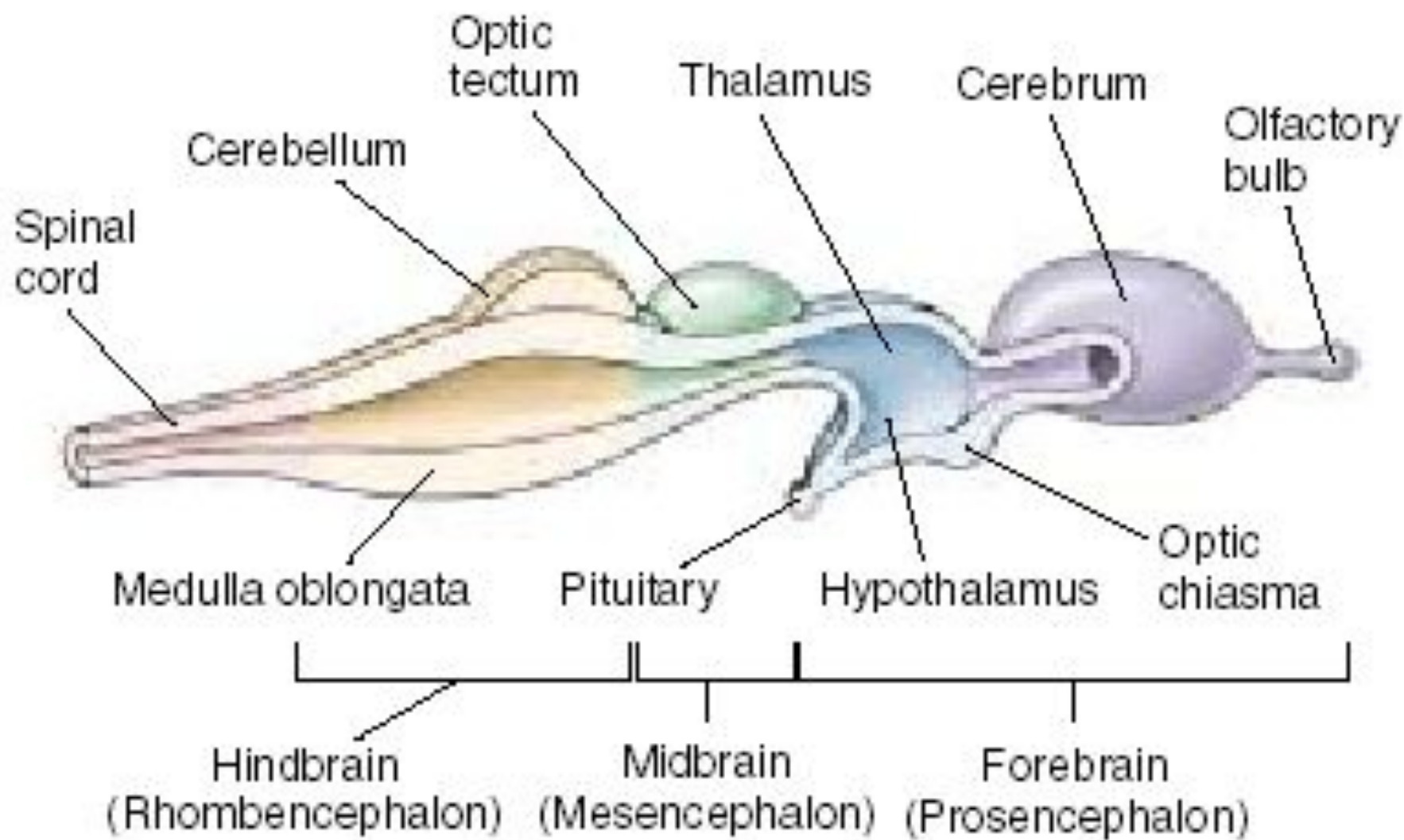
4. Птицы

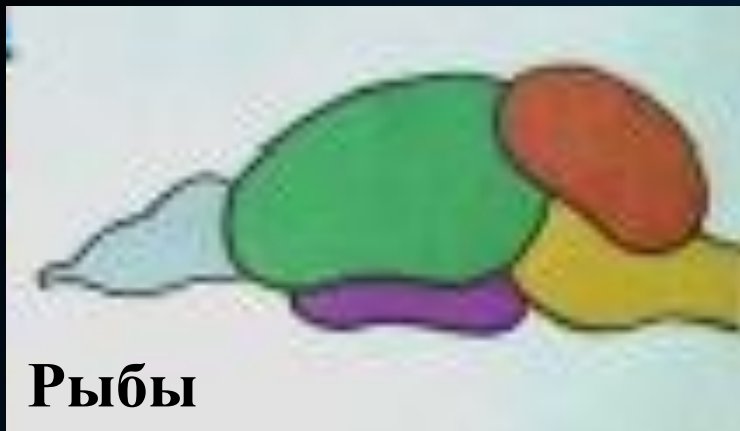
5. Млекопитающие



# Филогенез нервной системы хордовых







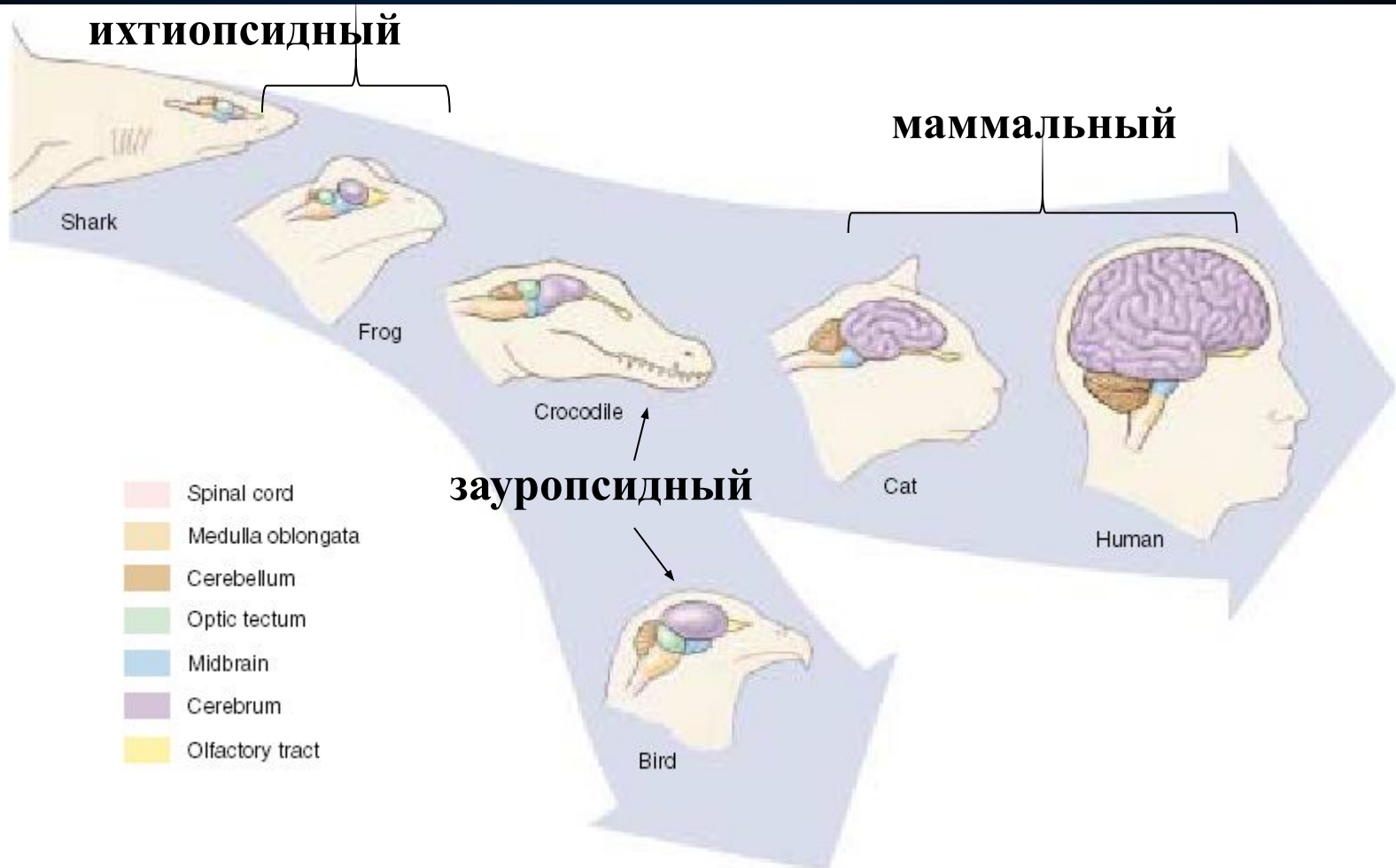
**зауропсидный**

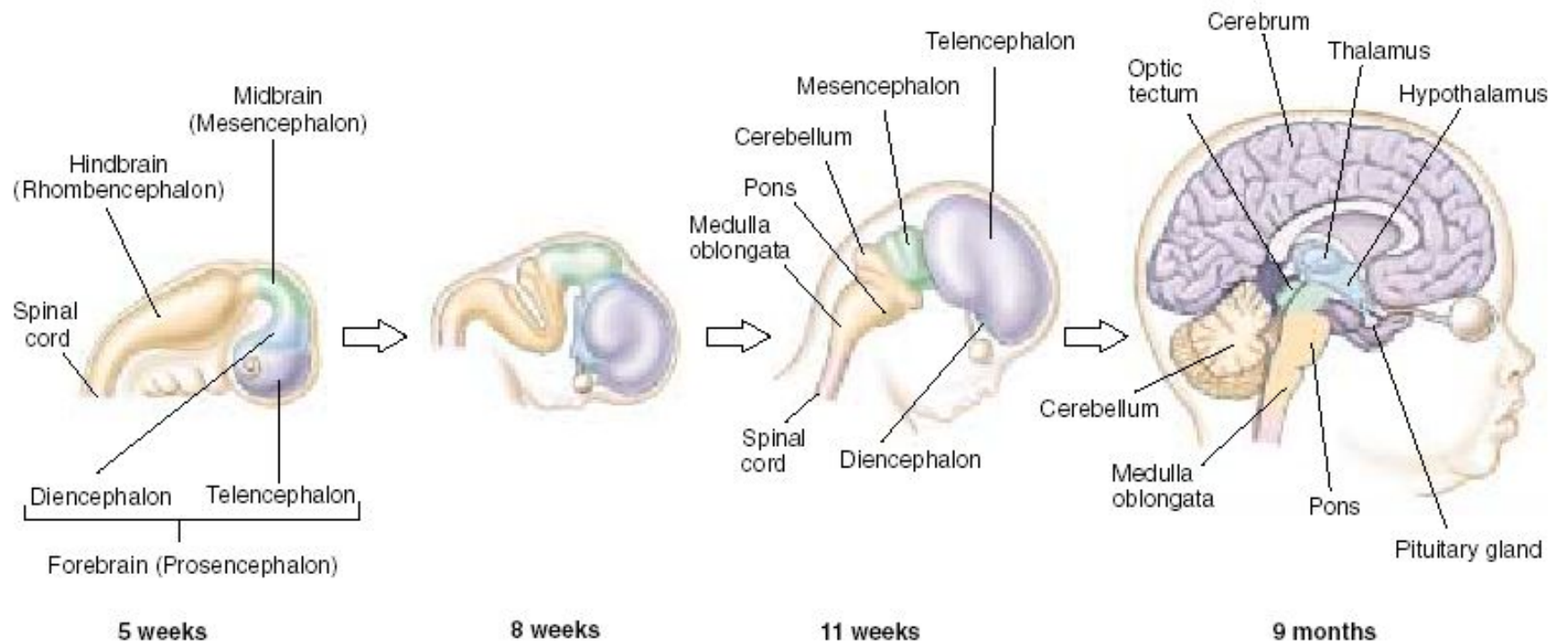
**ихтиопсидный**



**маммальный**

# Эволюция ЦНС хордовых



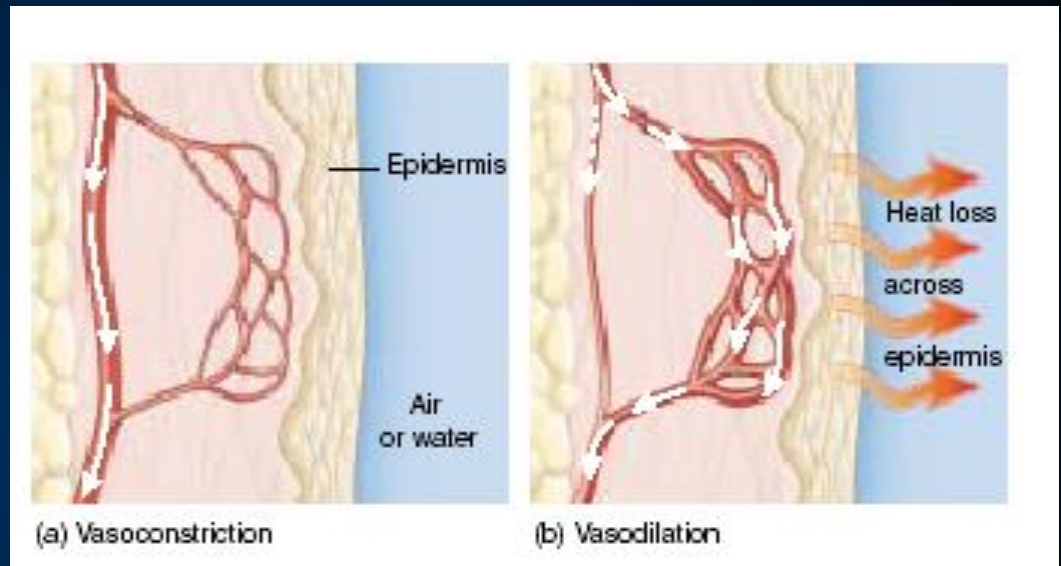
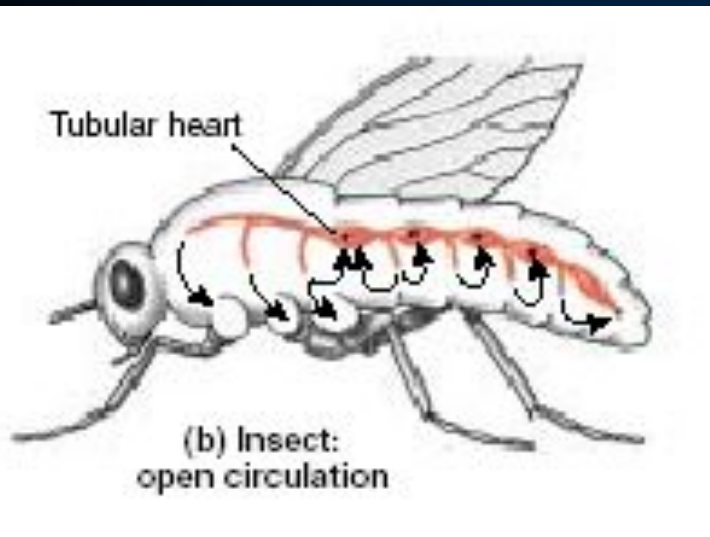




# Филогенез сердечно-сосудистой системы хордовых



# Сердечно-сосудистая система насекомых



\* Кровеносная система незамкнутая

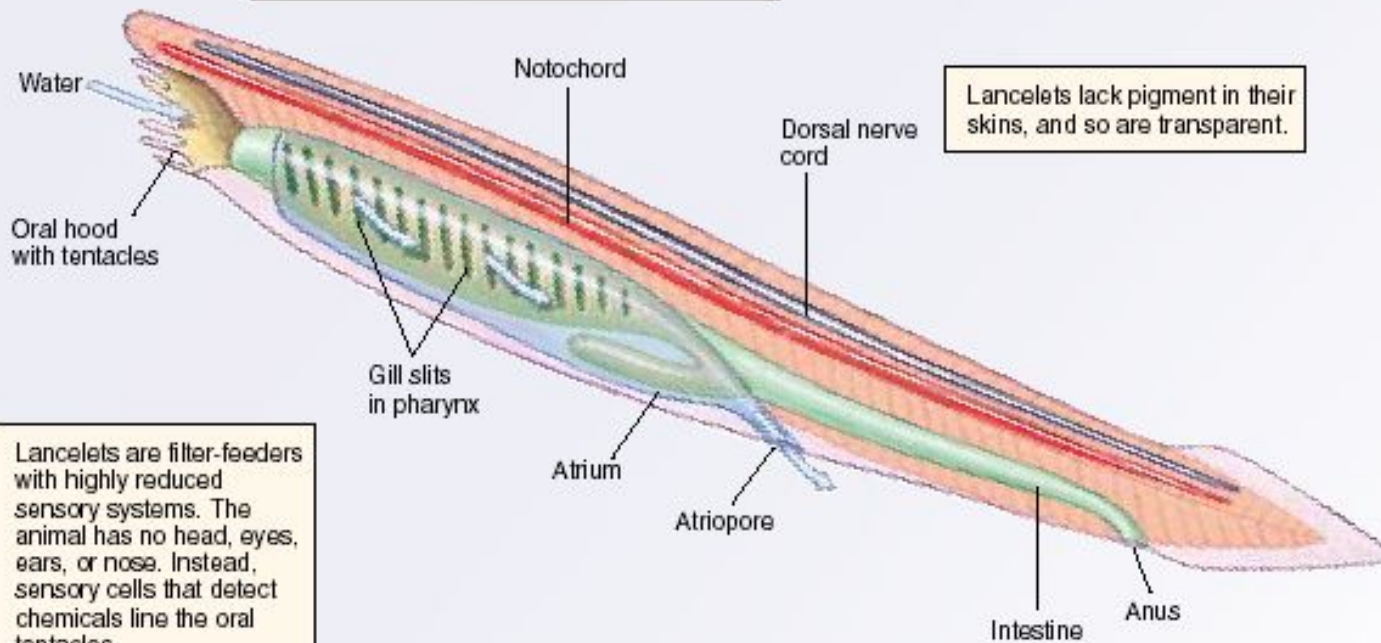
\* на спинной стороне – пульсирующий сосуд – прообраз сердца.

# Ланцетник – низшее хордовое животное



# Ланцетник – низшее хордовое животное

In a lancelet, the simplest chordate, the flexible notochord persists throughout life and aids swimming by giving muscles something to pull against. In the lancelet these muscles form a series of discrete blocks that can easily be seen. More advanced chordates have jointed appendages.



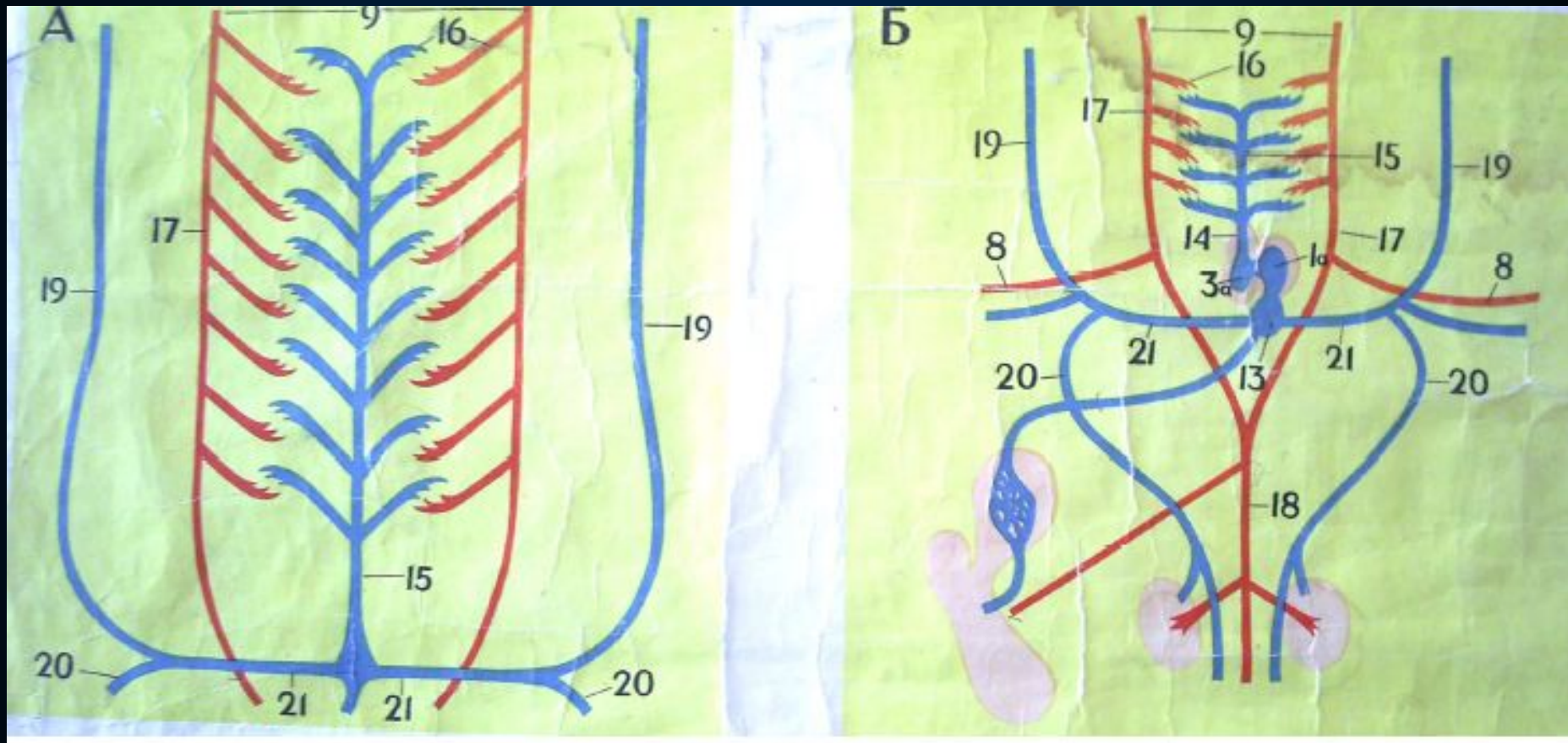
Lancelets lack pigment in their skins, and so are transparent.

Lancelets are filter-feeders with highly reduced sensory systems. The animal has no head, eyes, ears, or nose. Instead, sensory cells that detect chemicals line the oral tentacles.

Lancelets feed on microscopic protists caught by filtering them through cilia and gills on the pharyngeal slits. As the cilia that line the front end of the gut passage beat, they draw water through the mouth, through the pharynx, and out the slits.

Unlike that of vertebrates, the skin of a lancelet has only a single layer of cells.

# Филогенез сердечно-сосудистой системы хордовых

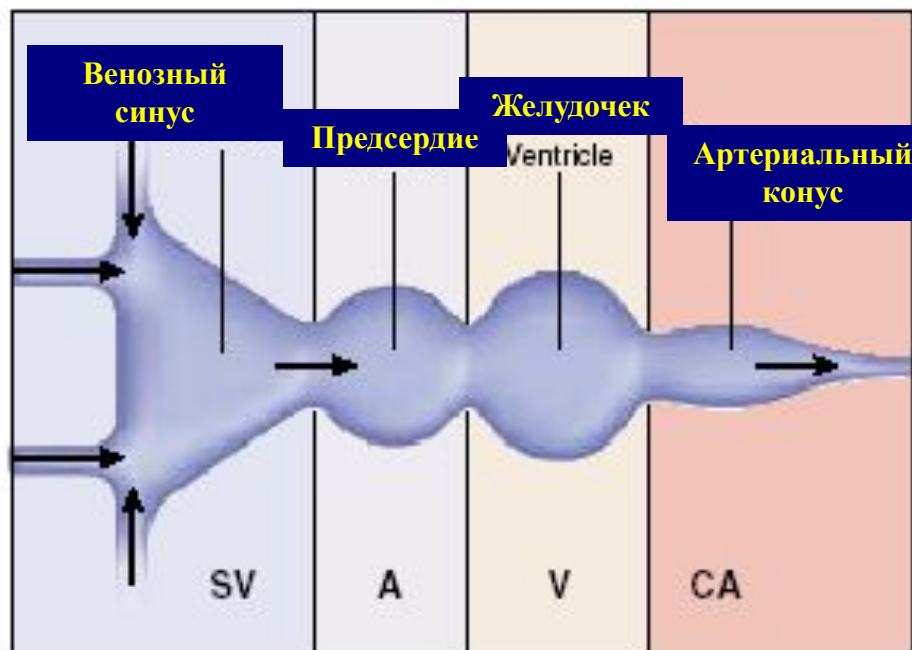


ланцетник

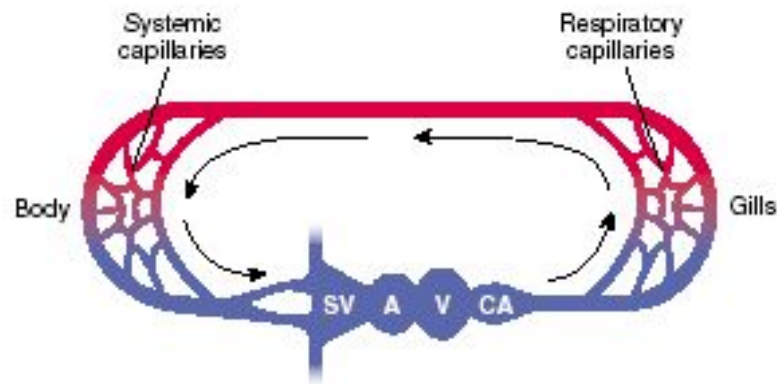
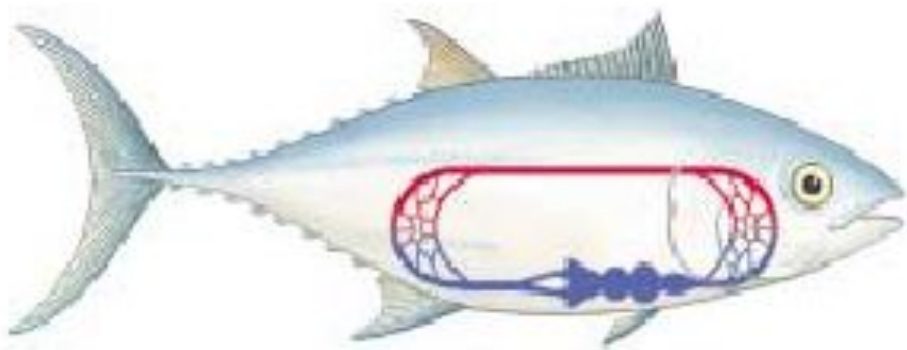
рыбы

# Сердечно-сосудистая система рыб:

1. **Замкнутая**
2. **1 круг кровообращения**
3. **2-х камерное сердце.**

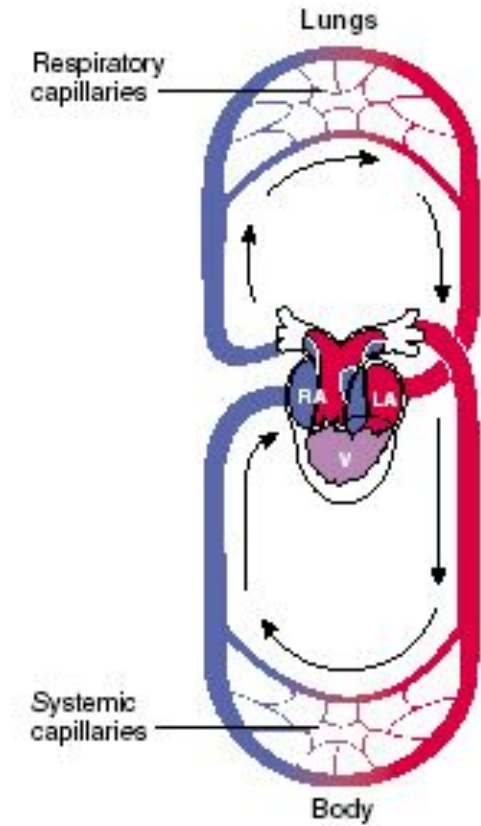
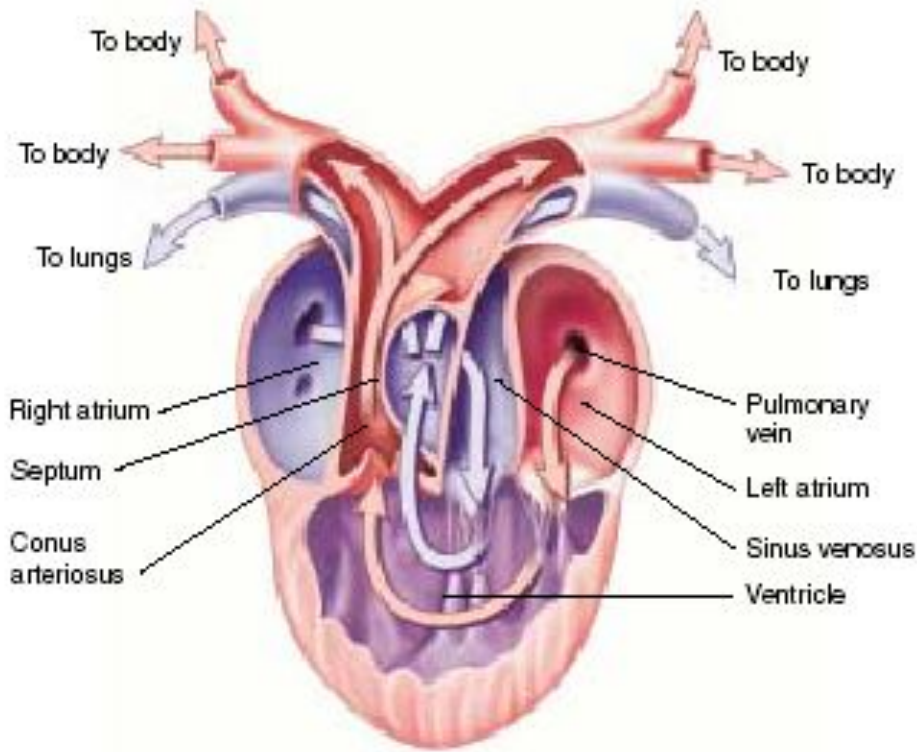


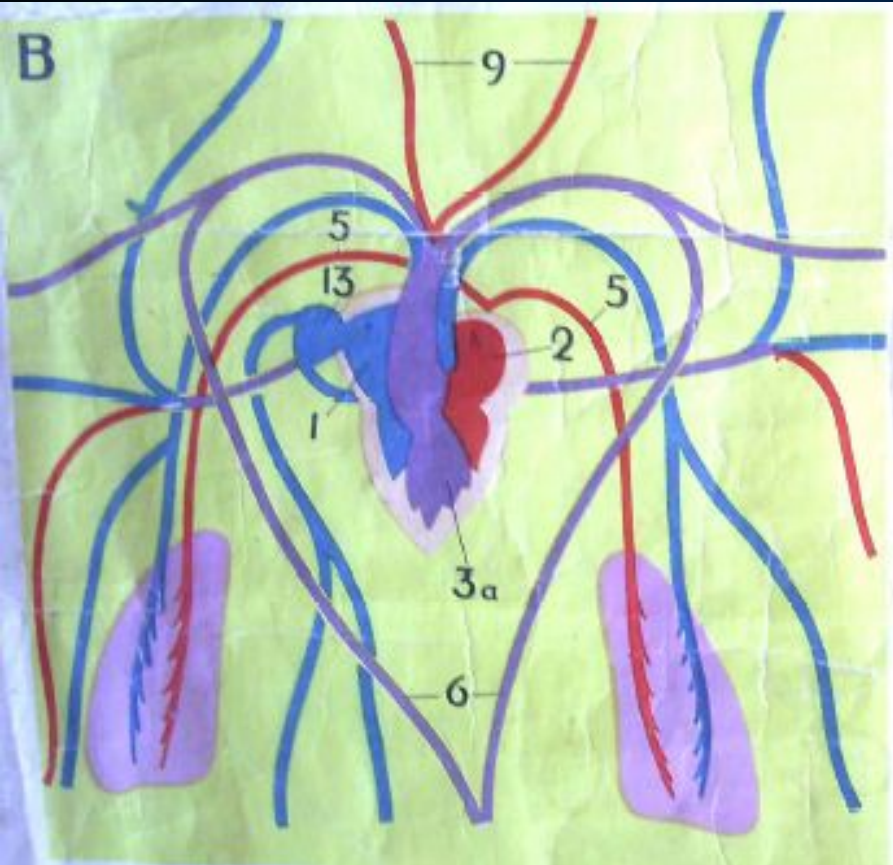
(a)



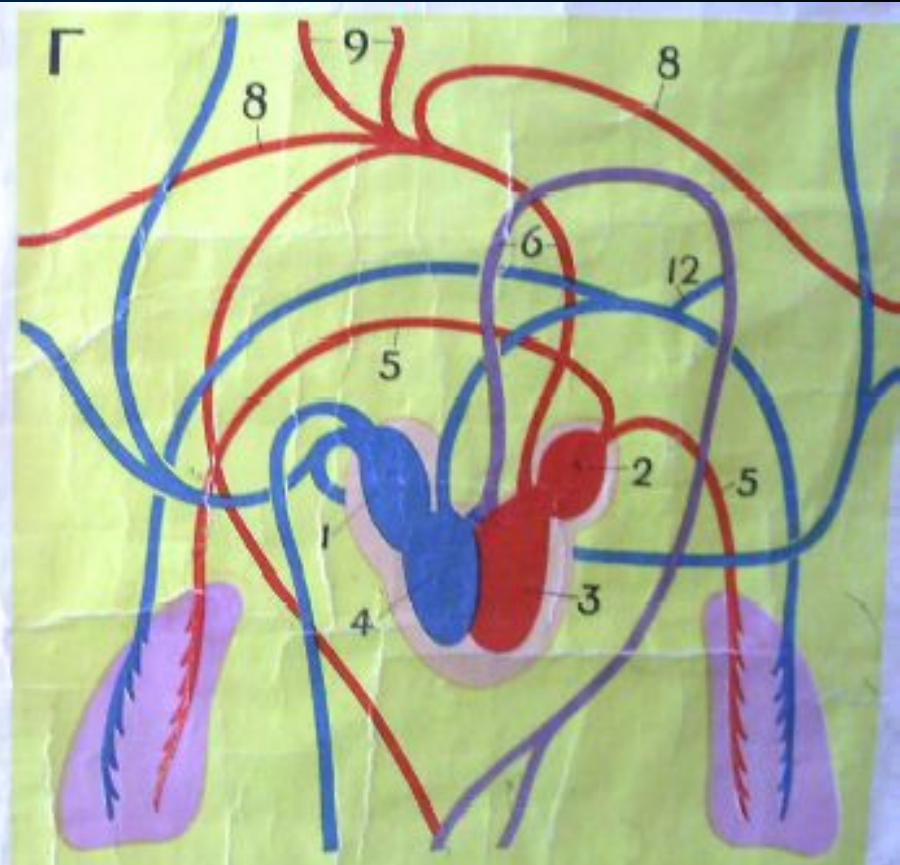
# Сердечно-сосудистая система амфибий

2 круга кровообращения, 3-х камерное сердце





**амфибии**

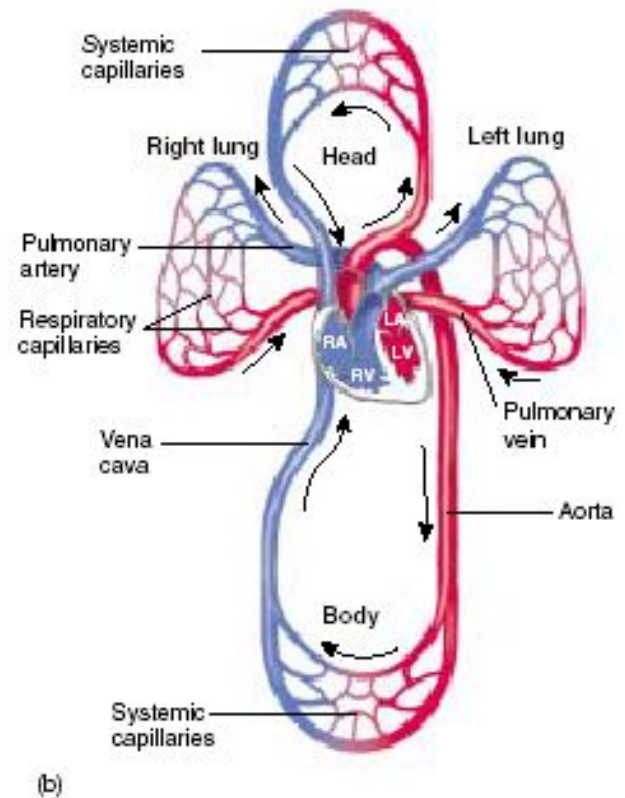
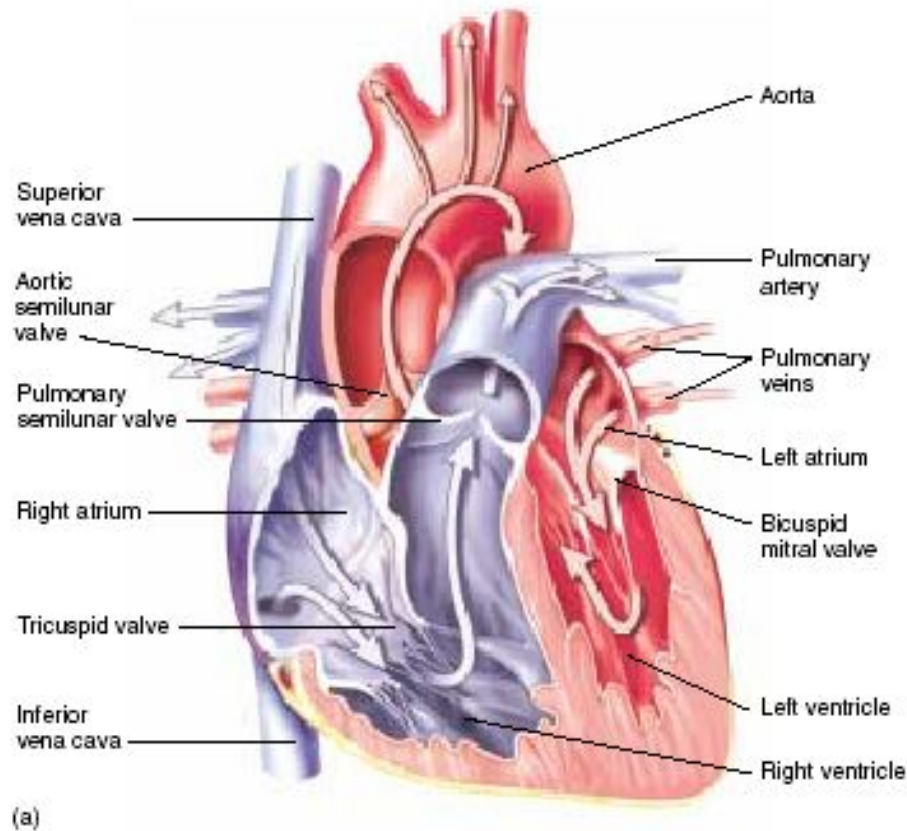


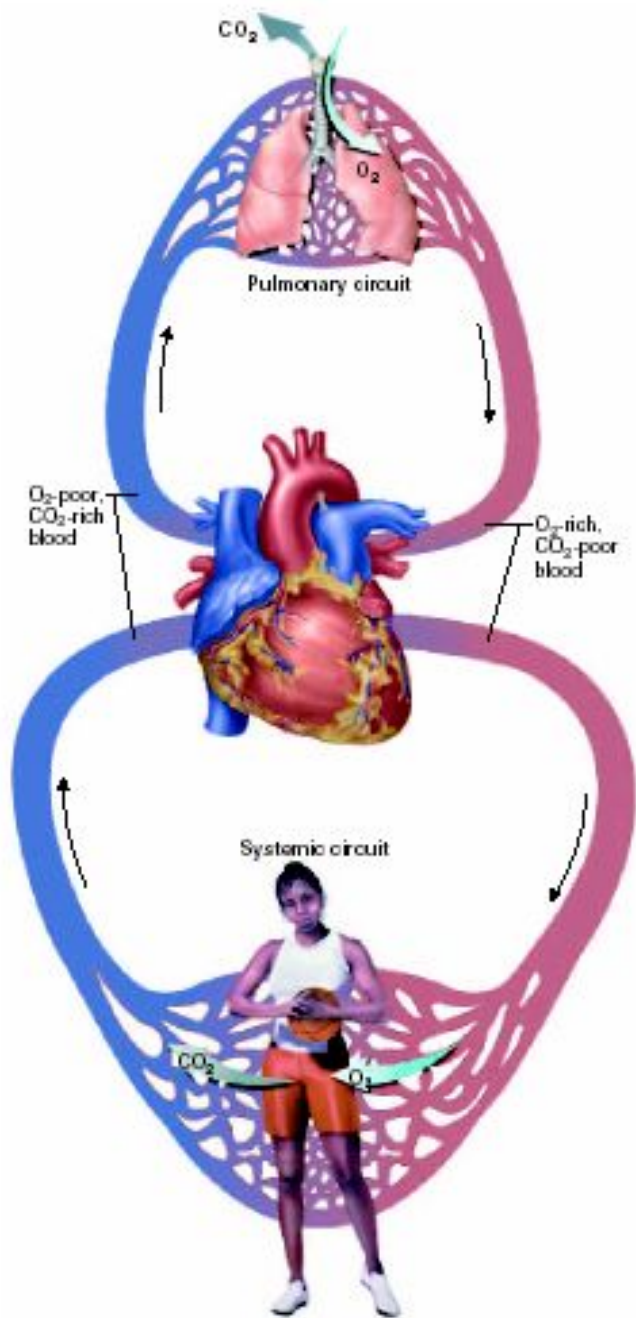
**пресмыкающиеся**



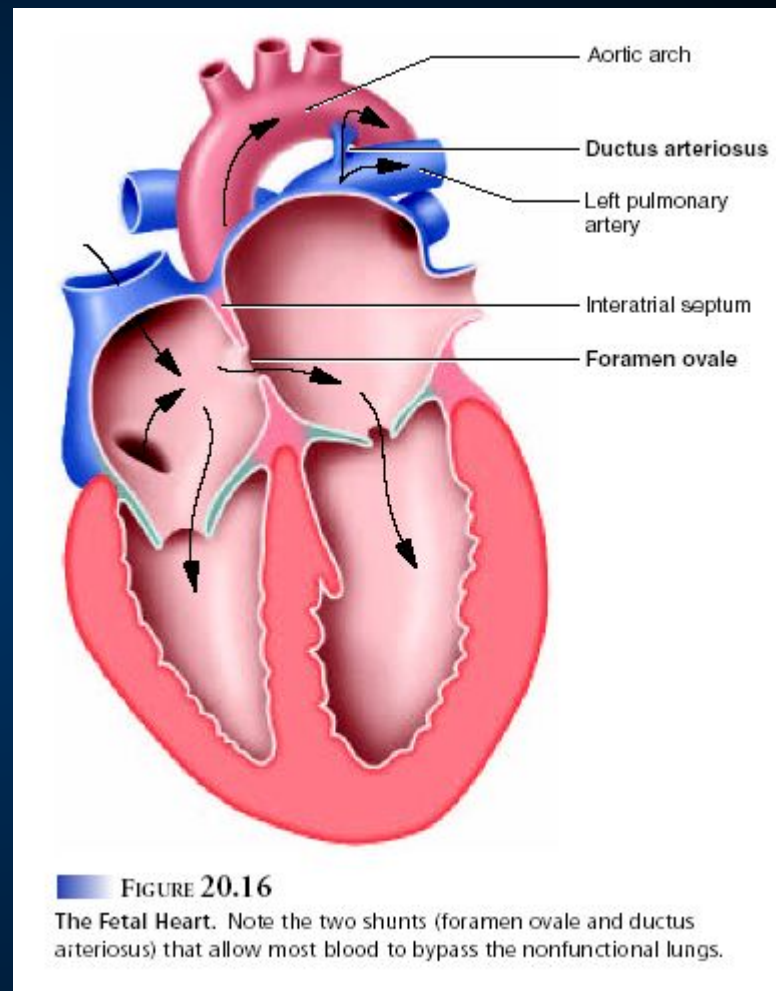
# Сердечно-сосудистая система млекопитающих и человека

## 2 круга кровообращения. 4-х камерное сердце

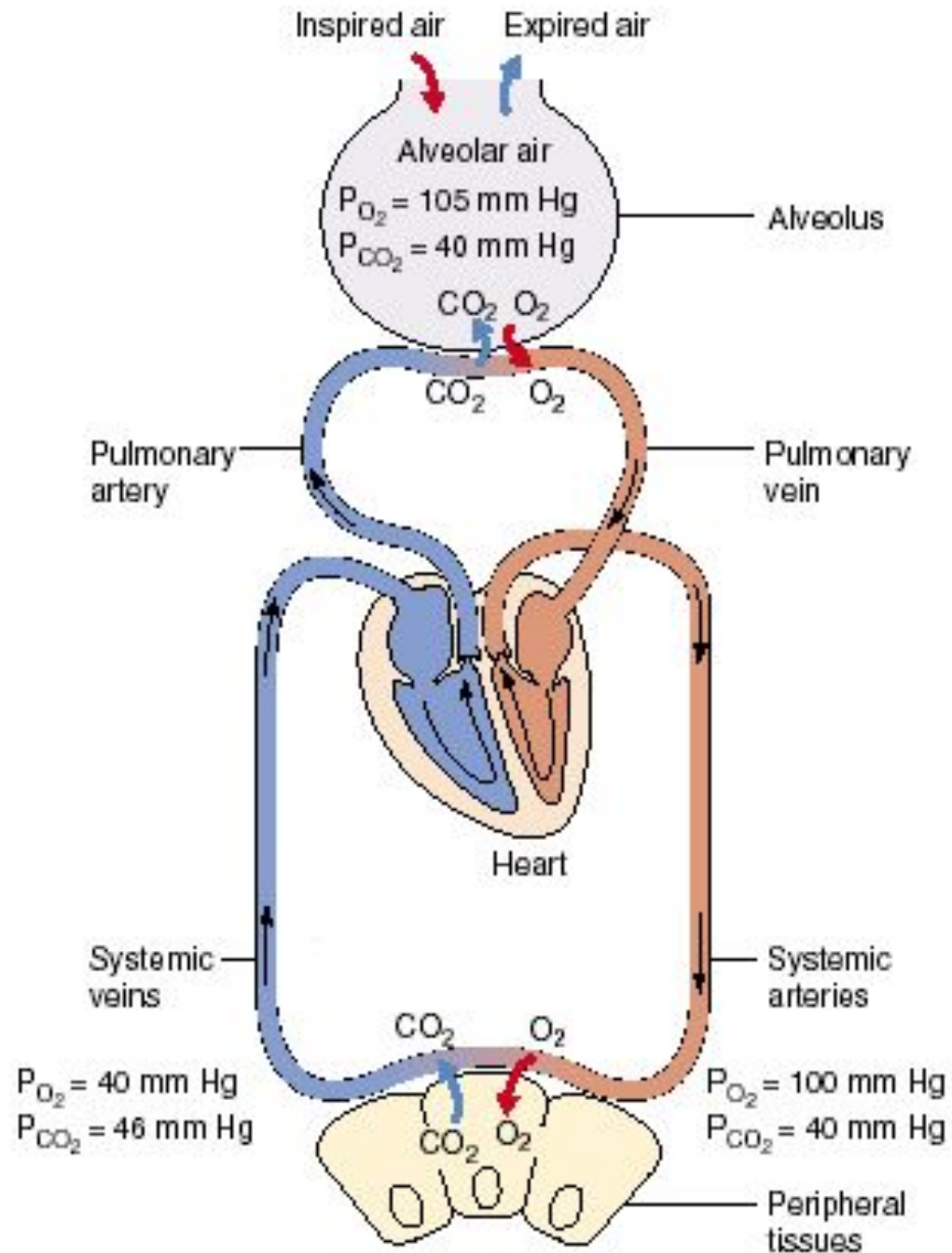


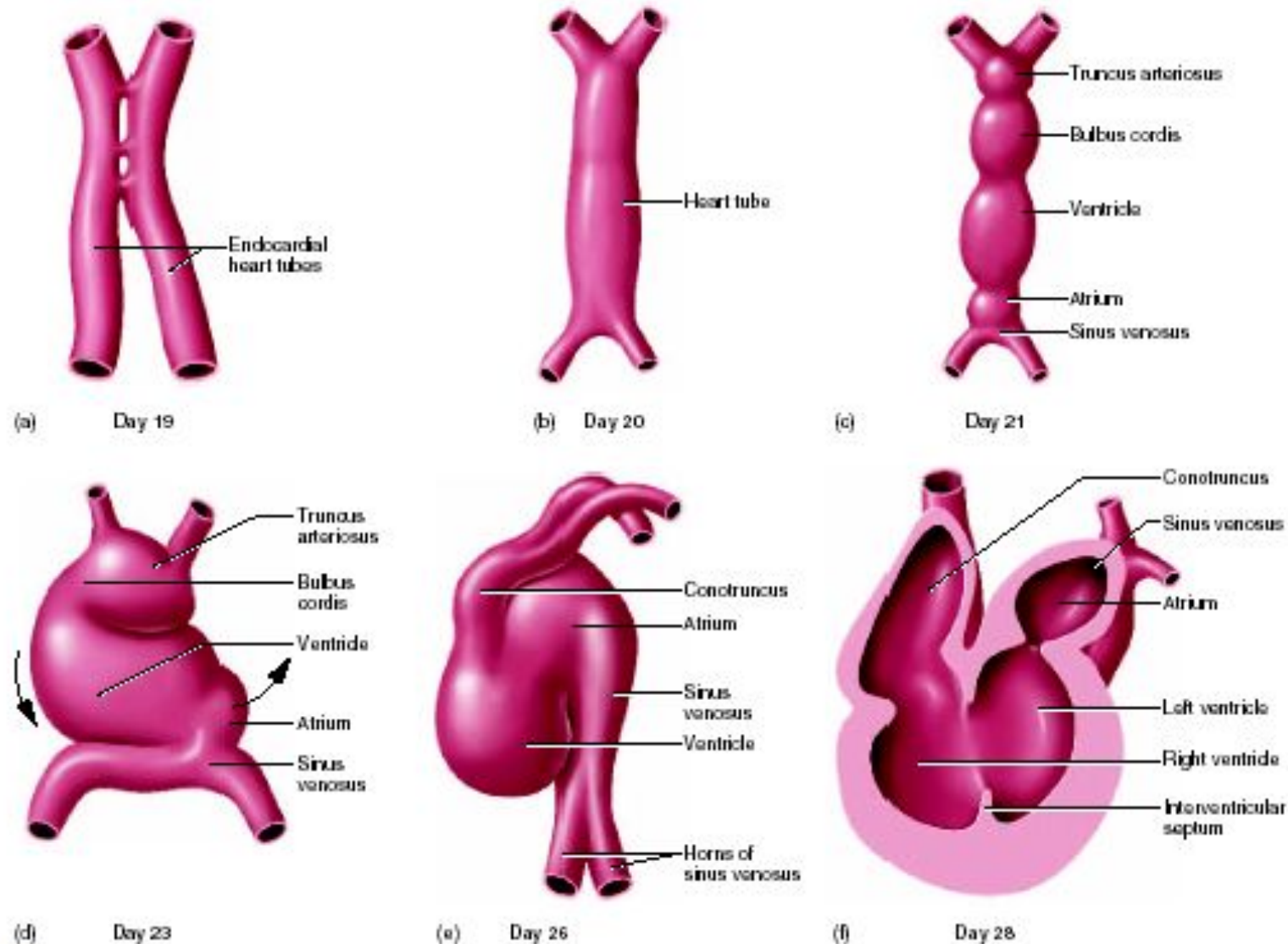


**FIGURE 20.1**  
General Schematic of the Cardiovascular System.



Полное разделение  
большого и малого  
кругов кровообращения  
– одна из главных  
предпосылок  
возникновения  
тепнокровности





**FIGURE 20.15**

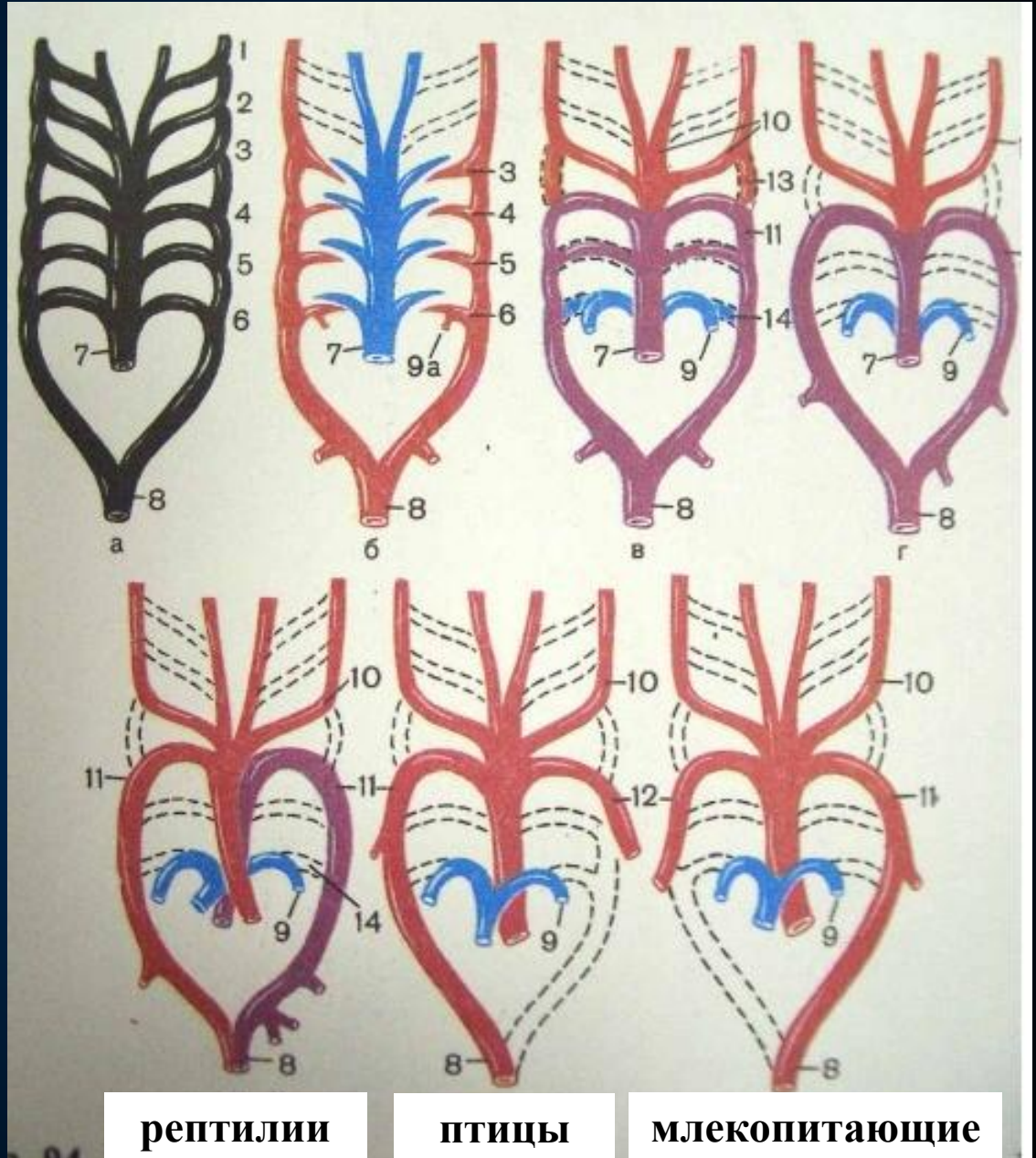
**Embryonic Development of the Heart.** (a) The endocardial heart tubes beginning to fuse at day 19. (b) Complete fusion by day 20, forming the heart tube. (c) Division of the heart tube into five dilated segments by day 21. The heart begins beating about a day later. (d) The heart begins looping around day 23, with the bulbus cordis migrating caudally (left arrow) and the atrium and sinus venosus migrating rostrally (right arrow). Blood circulates throughout the embryo within a day of this stage. (e) Looping is nearly completed by day 26. (f) Frontal section of the heart at 28 days. As the interventricular septum develops, the conotruncus will divide longitudinally into the ascending aorta and pulmonary trunk, receiving blood from the left and right ventricles, respectively. The single atrium seen here divides into the right and left atria by day 33.

**Филогенетическое  
преобразования  
жаберных дуг  
хордовых**

зародыш  
позвоночных

рыбы

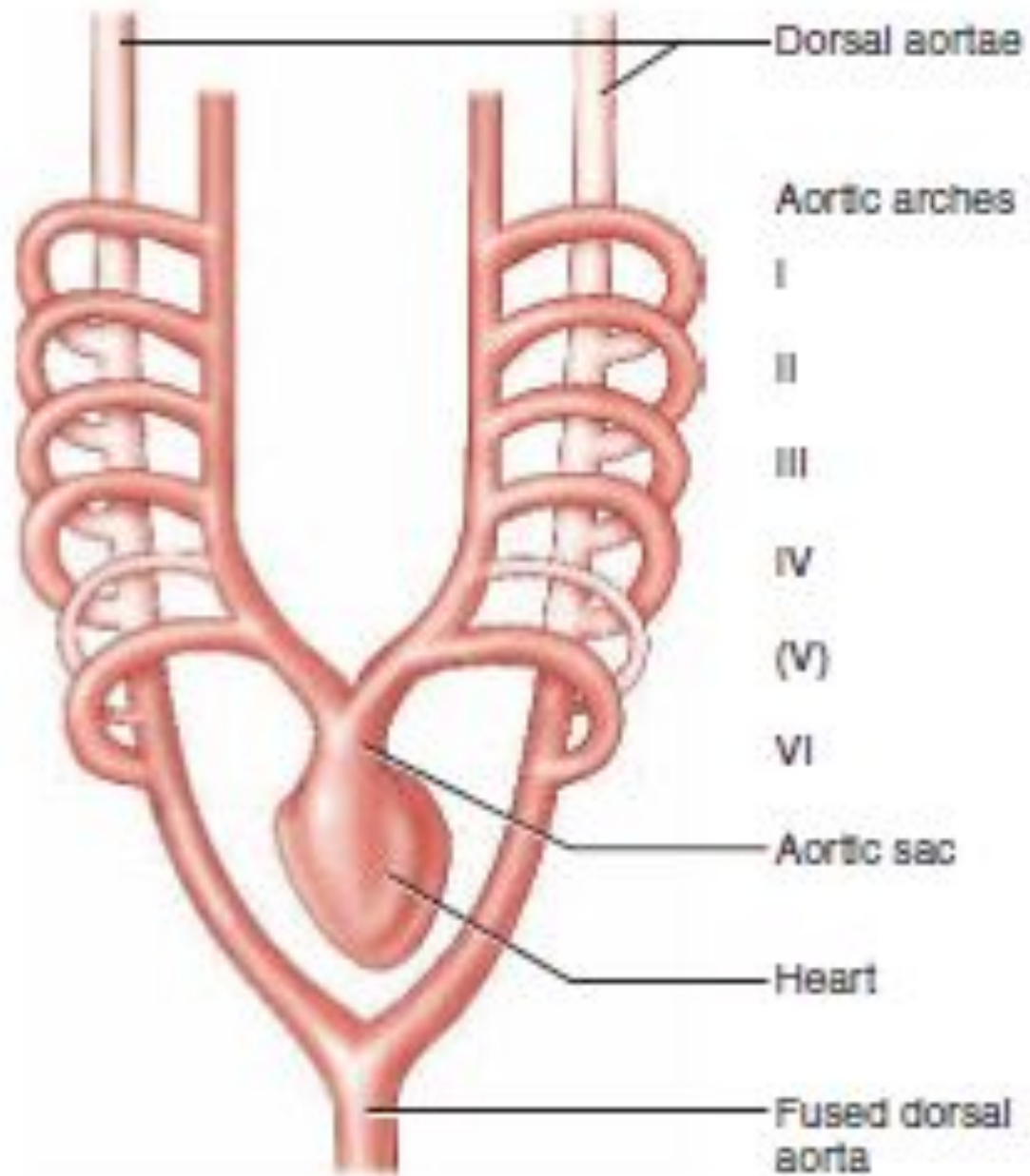
амфибии

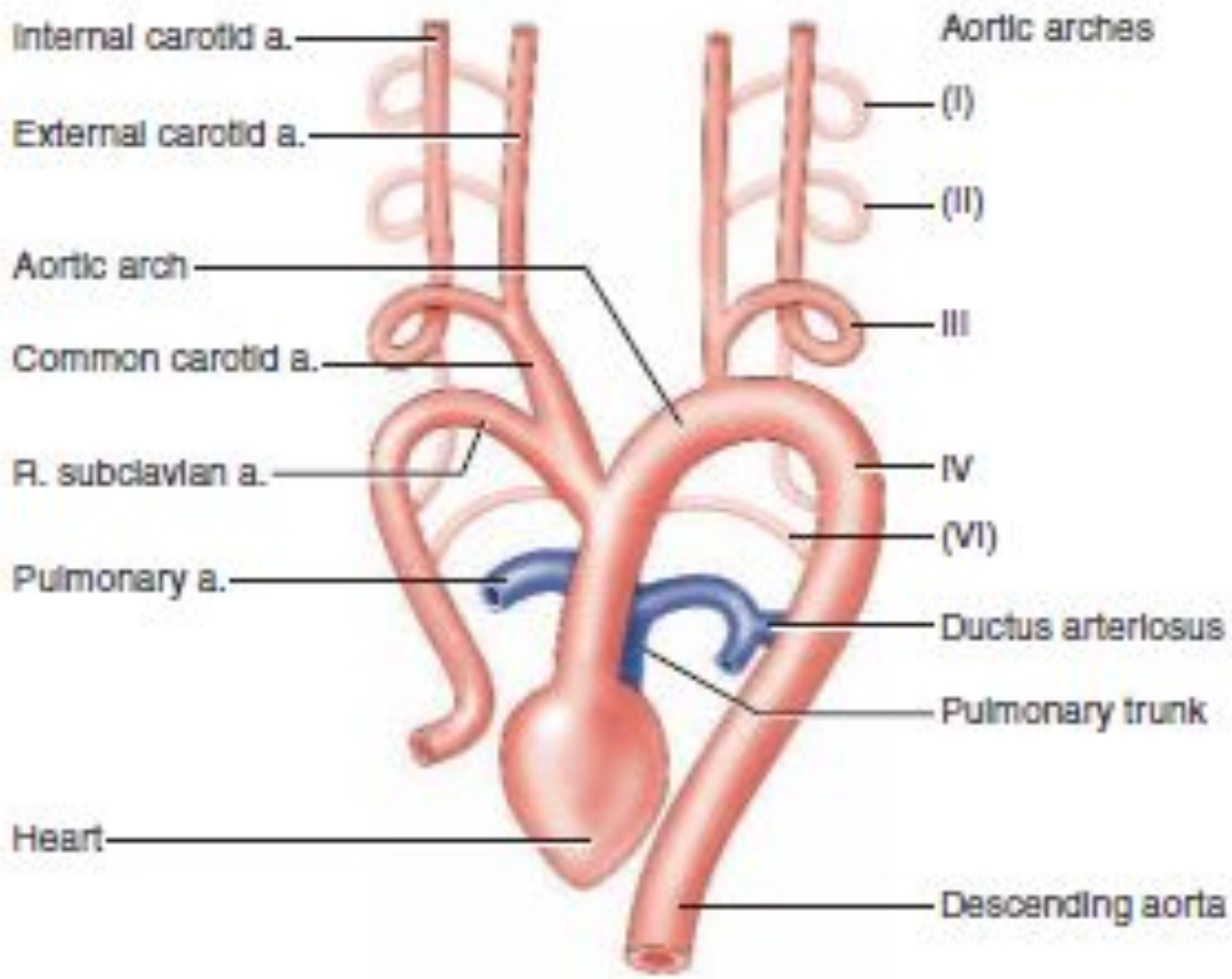


рептилии

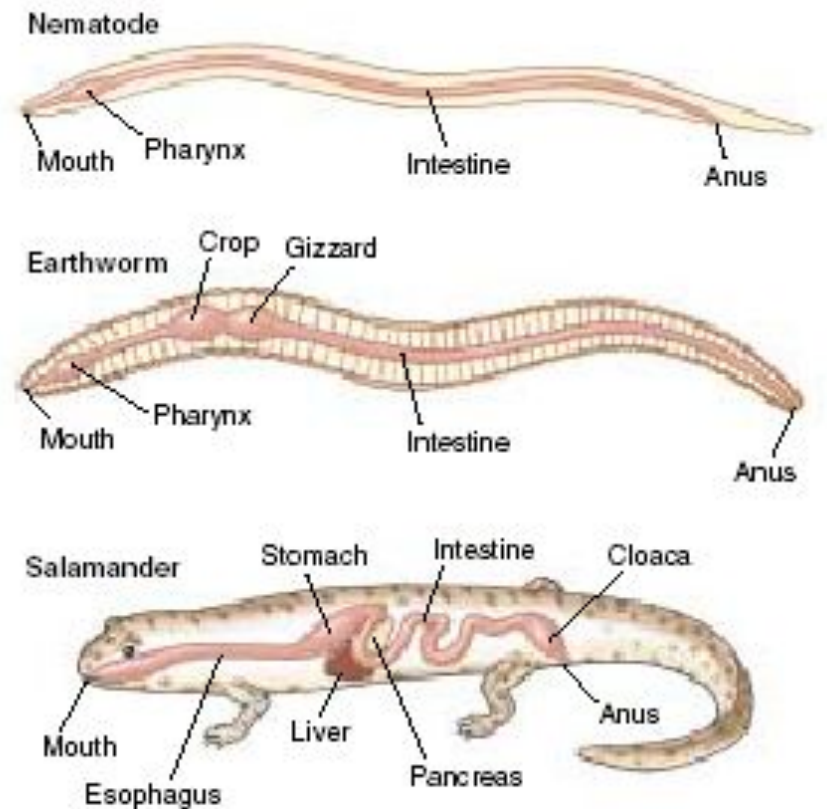
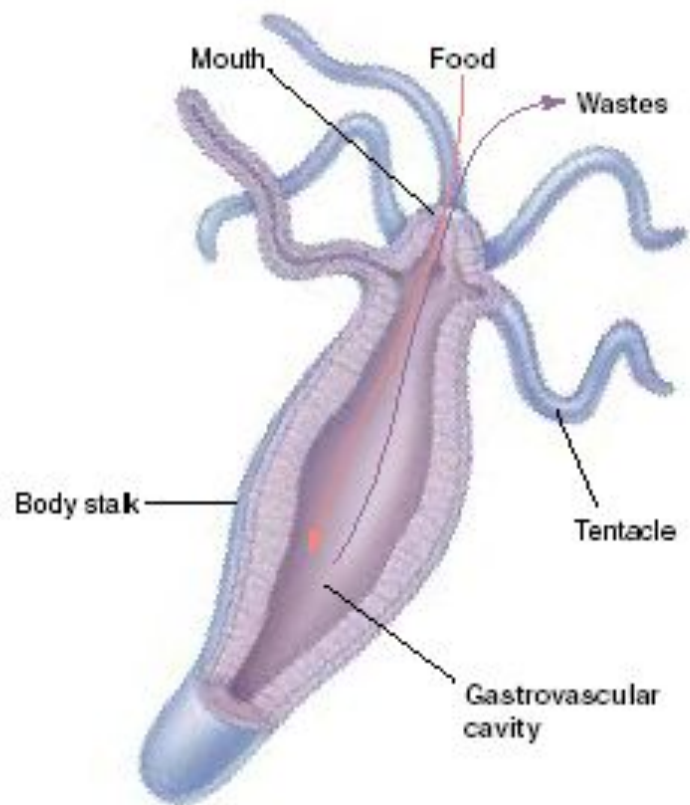
птицы

млекопитающие

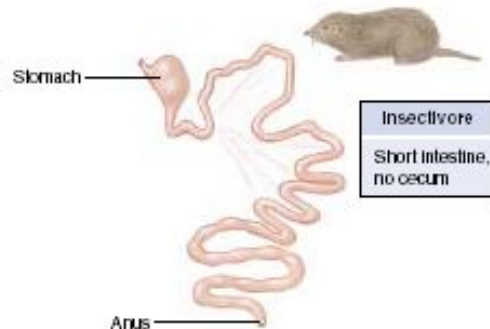




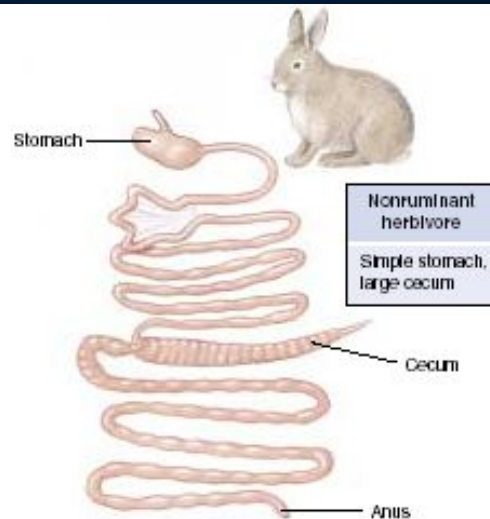
# Филогенез пищеварительной системы хордовых



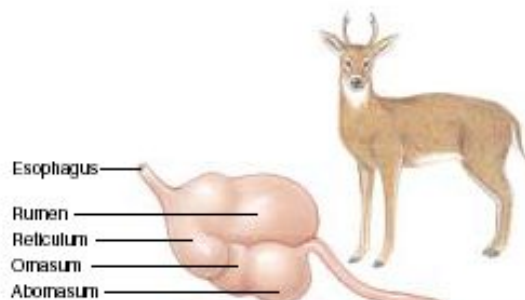




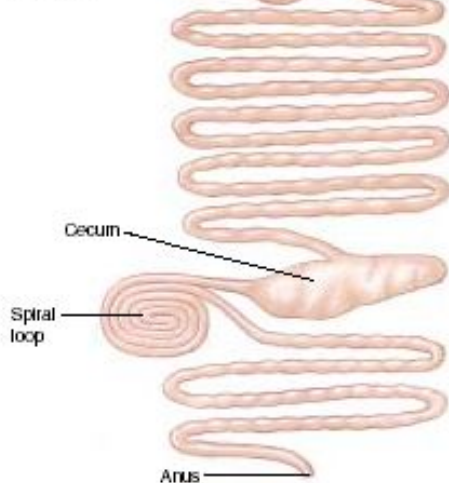
**Insectivore**  
Short intestine,  
no cecum



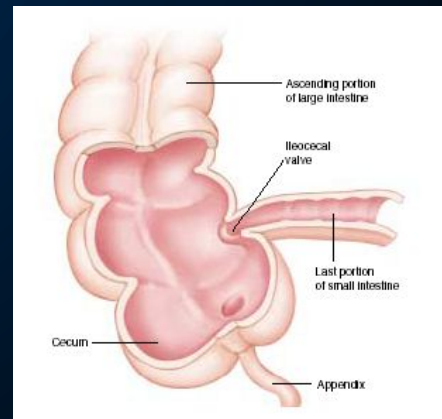
**Nonruminant herbivore**  
Simple stomach,  
large cecum

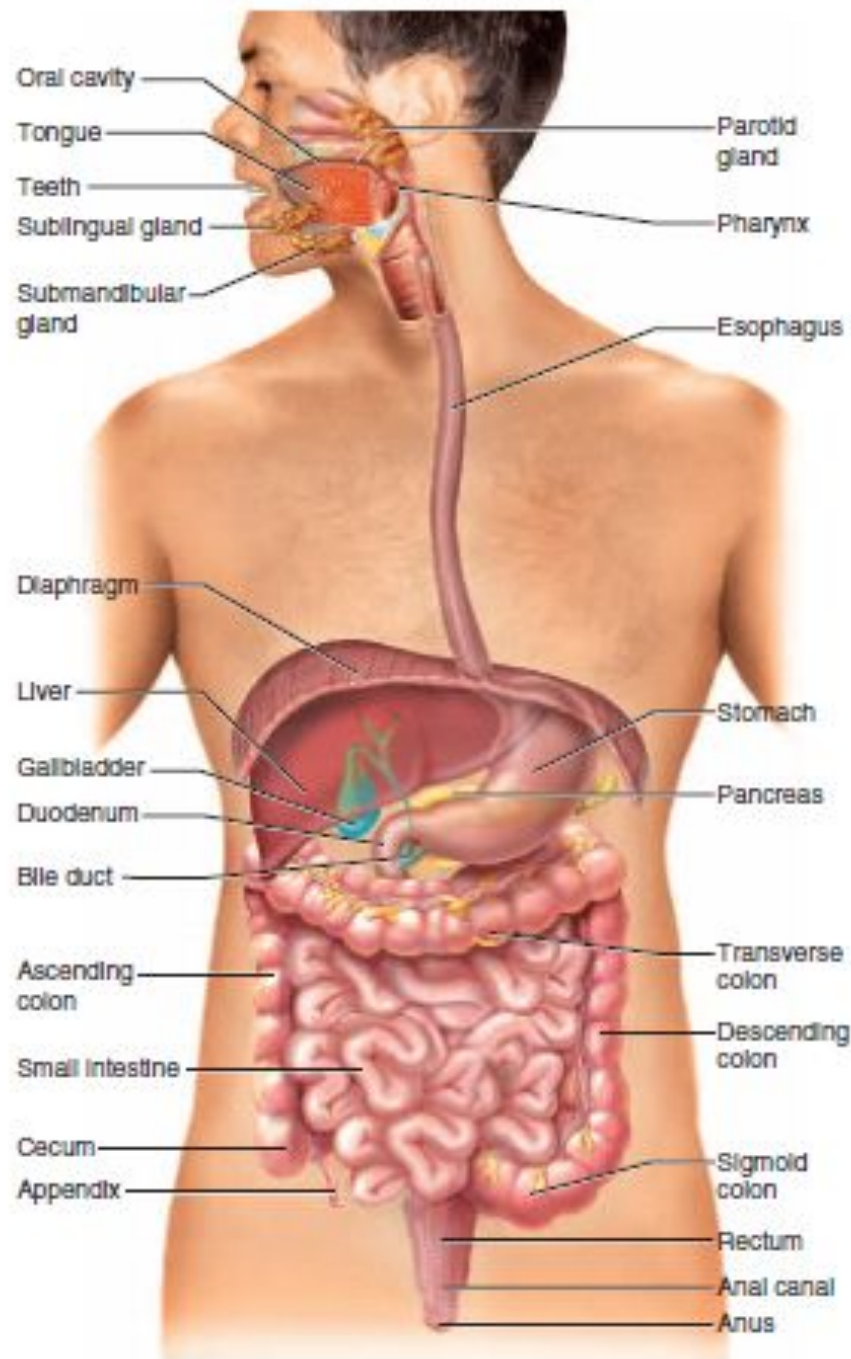


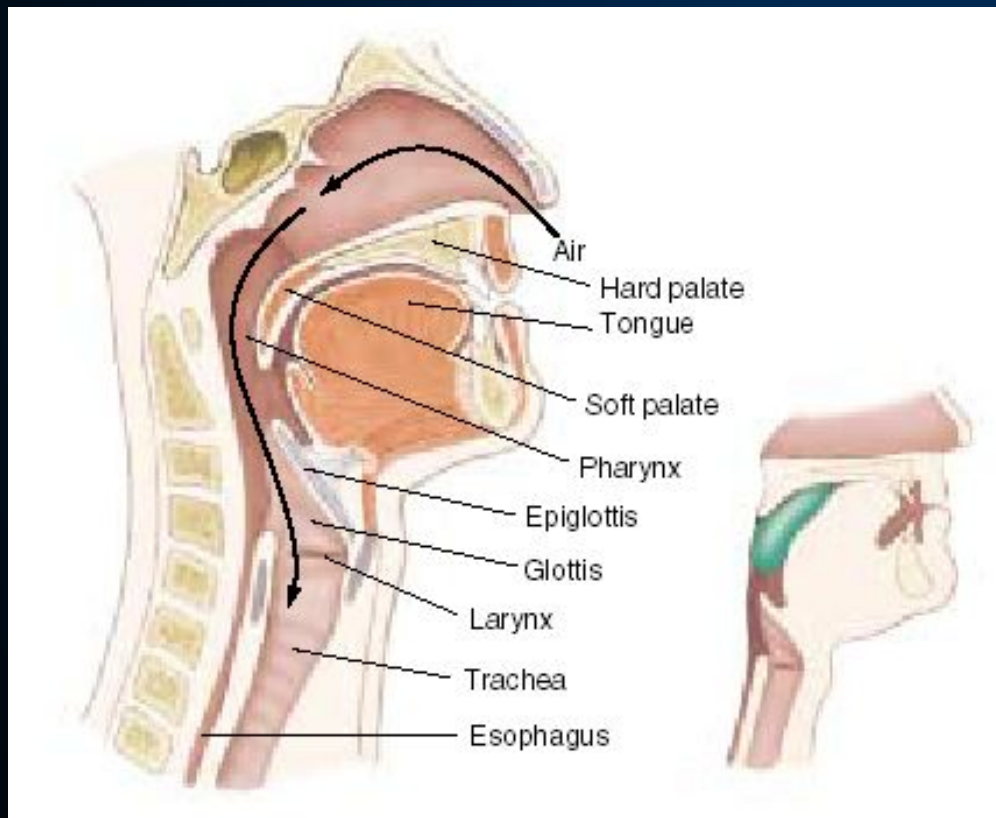
**Ruminant herbivore**  
Four-chambered  
stomach with  
large rumen;  
long small and  
large intestine



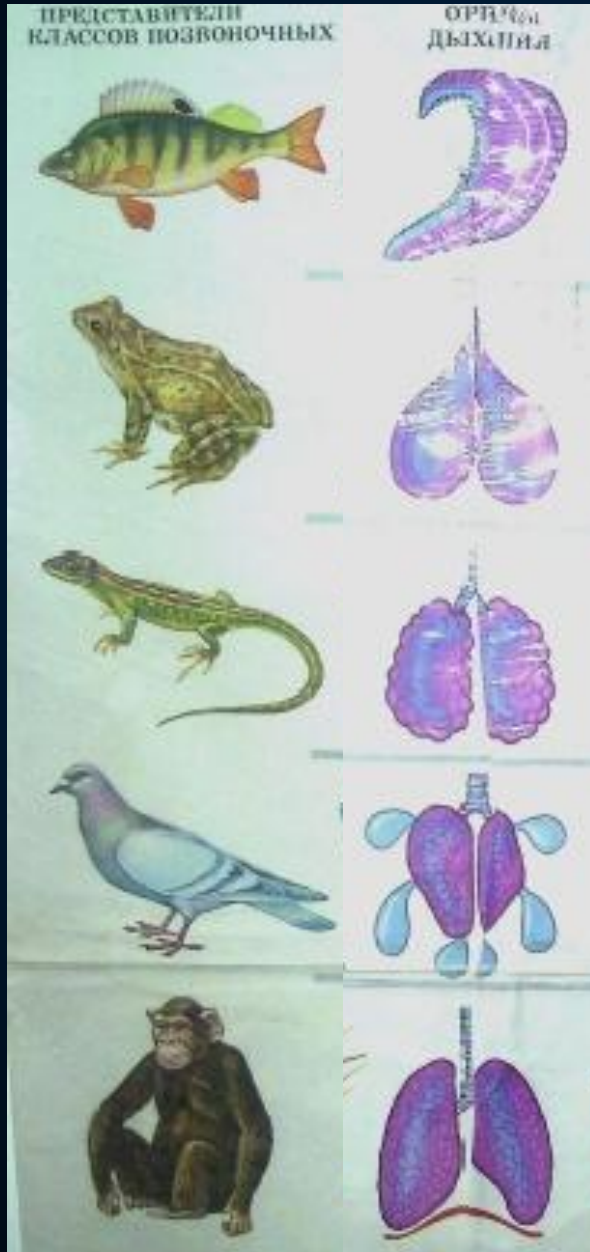
**Carnivore**  
Short intestine  
and colon,  
small cecum



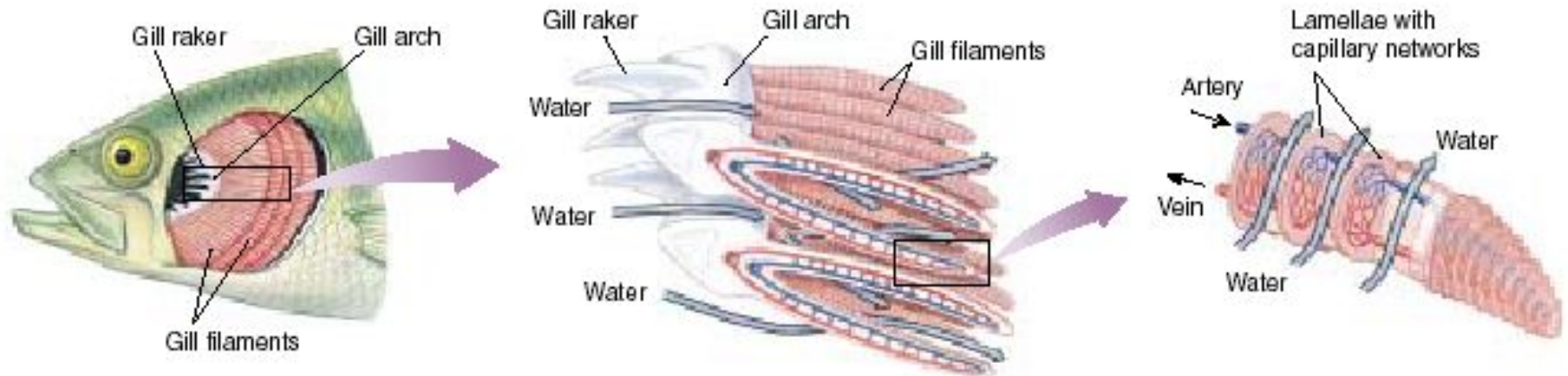
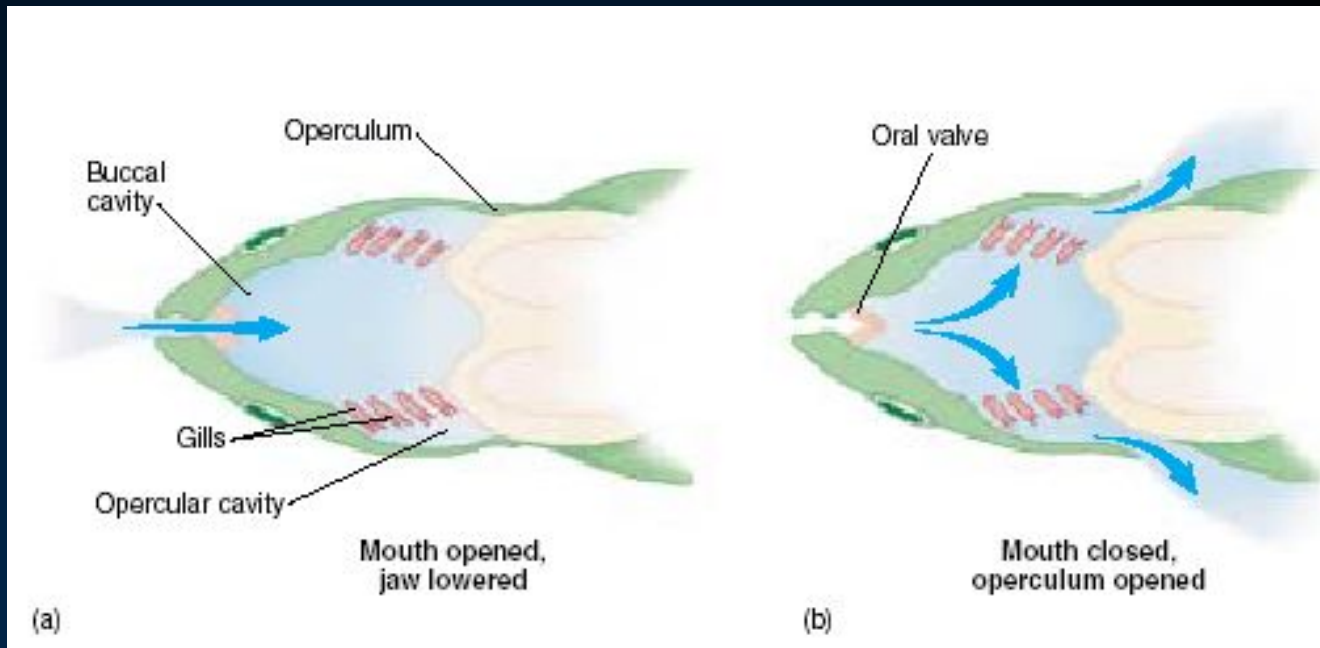




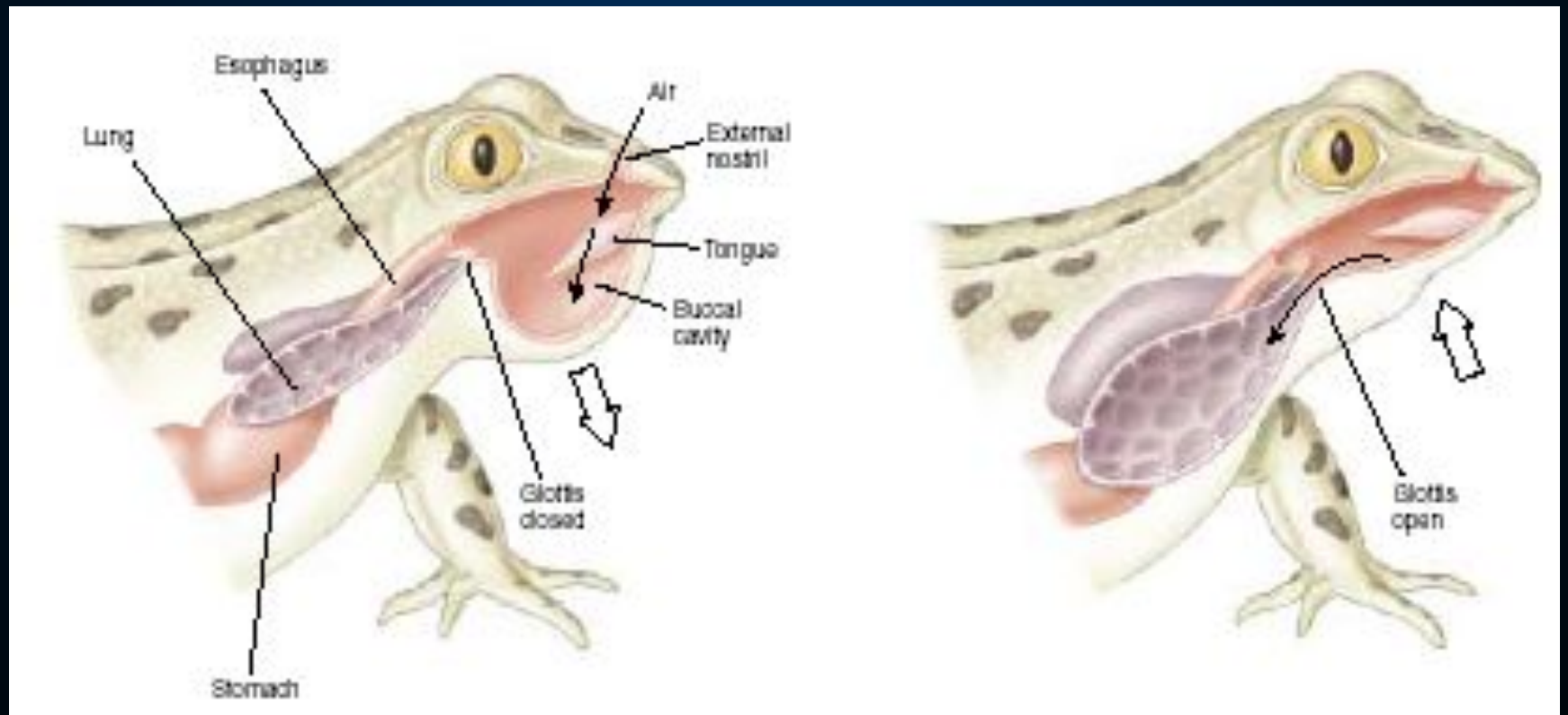
# Филогенез дыхательной системы хордовых



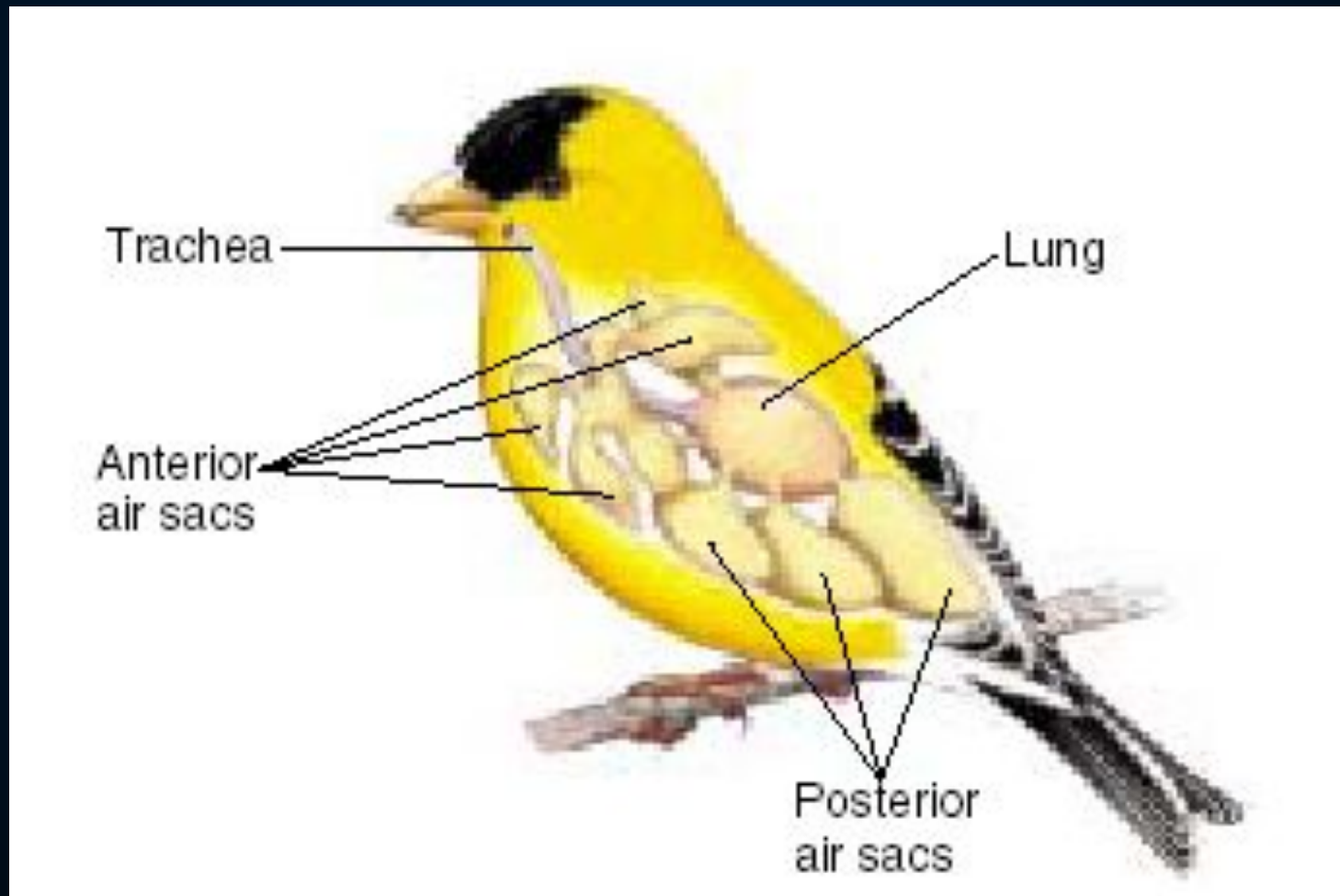
# Жаберное дыхание у рыб



# Появление легочных мешков у земноводных (производные плавательного пузыря рыб)

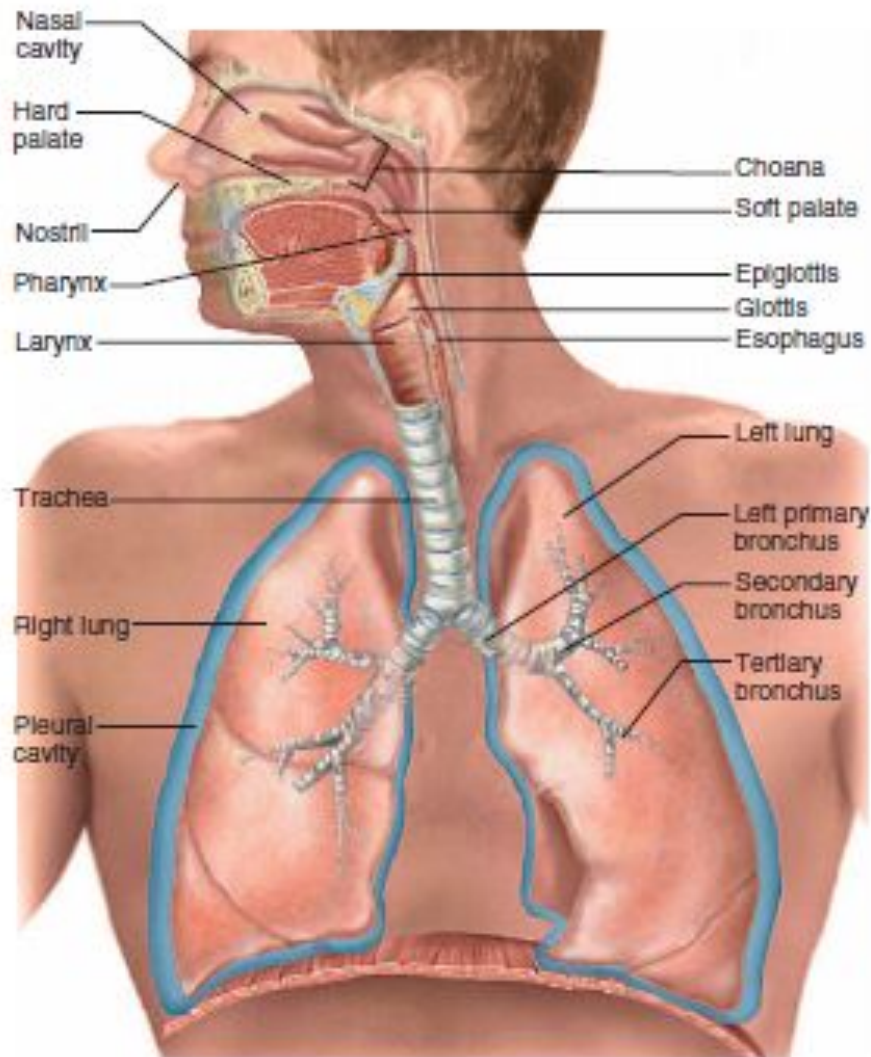


## Крупноячеистые легкие у птиц





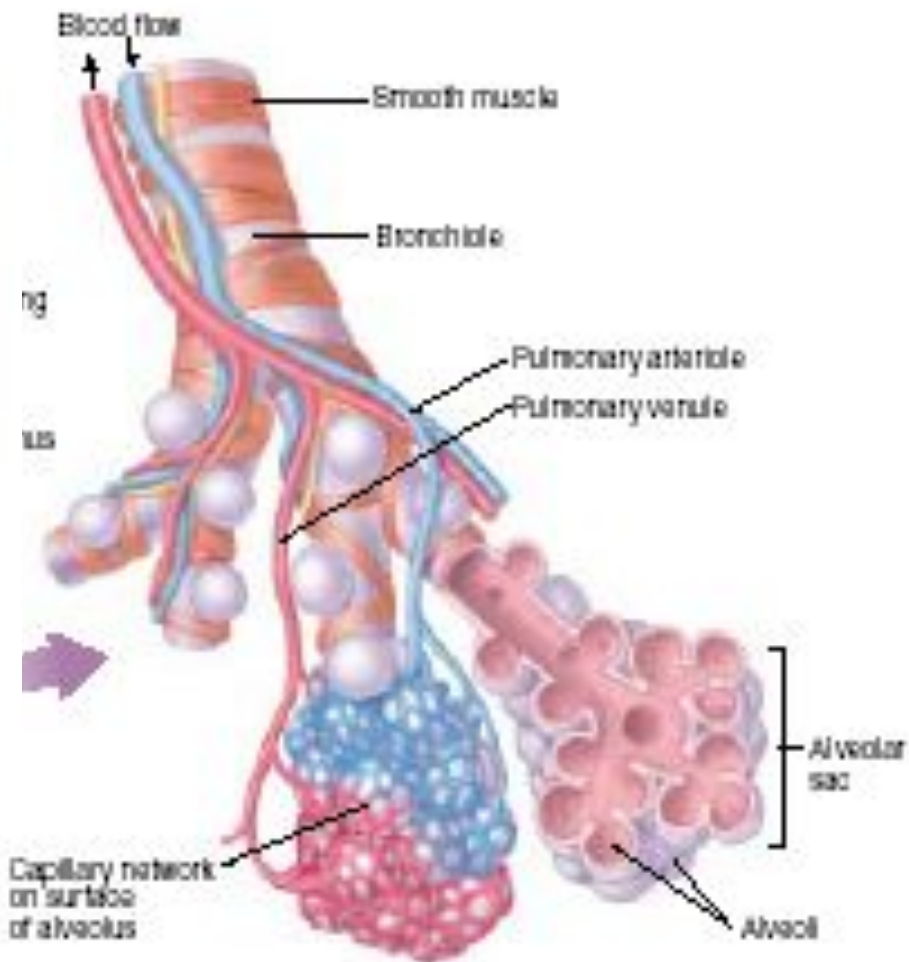




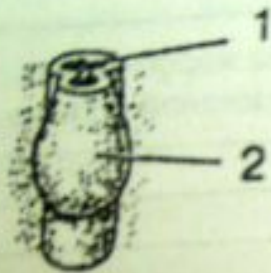
**FIGURE 23.1**  
The Respiratory System.

## Органы дыхания у человека:

**Нос носоглотка гортань трахея  
bronхи бронхиолы альвеолы**



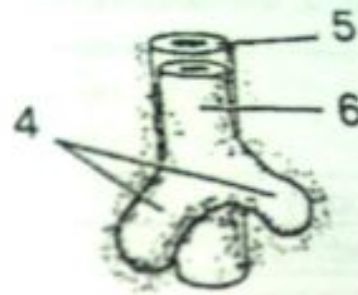
# Онтогенез органов дыхания у млекопитающих



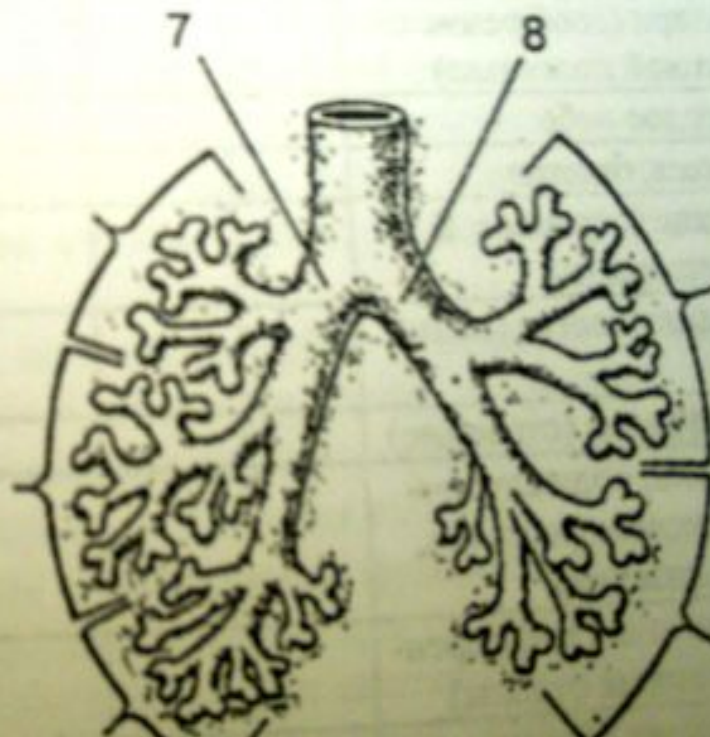
А.

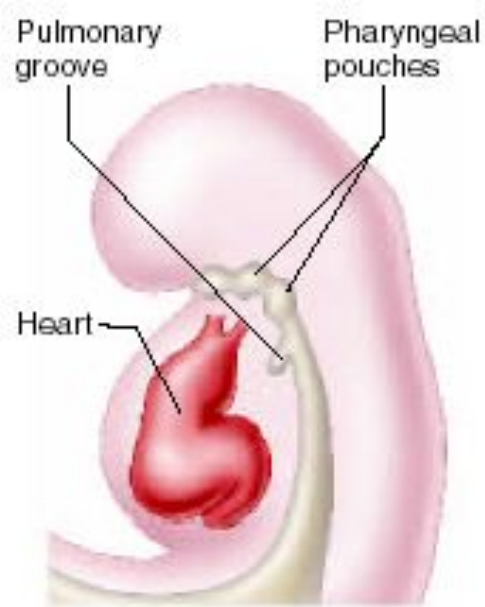


Б.

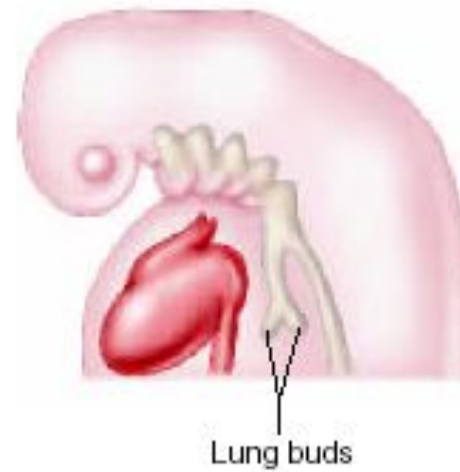


В.

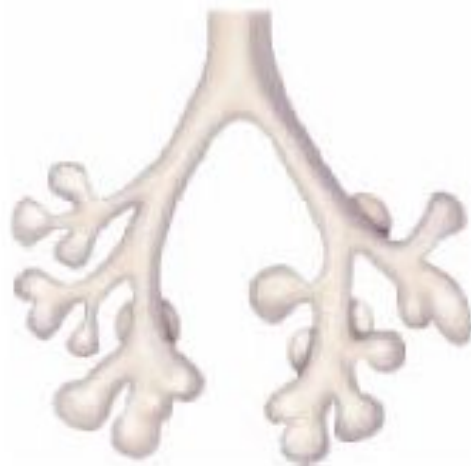




3 weeks



4 weeks



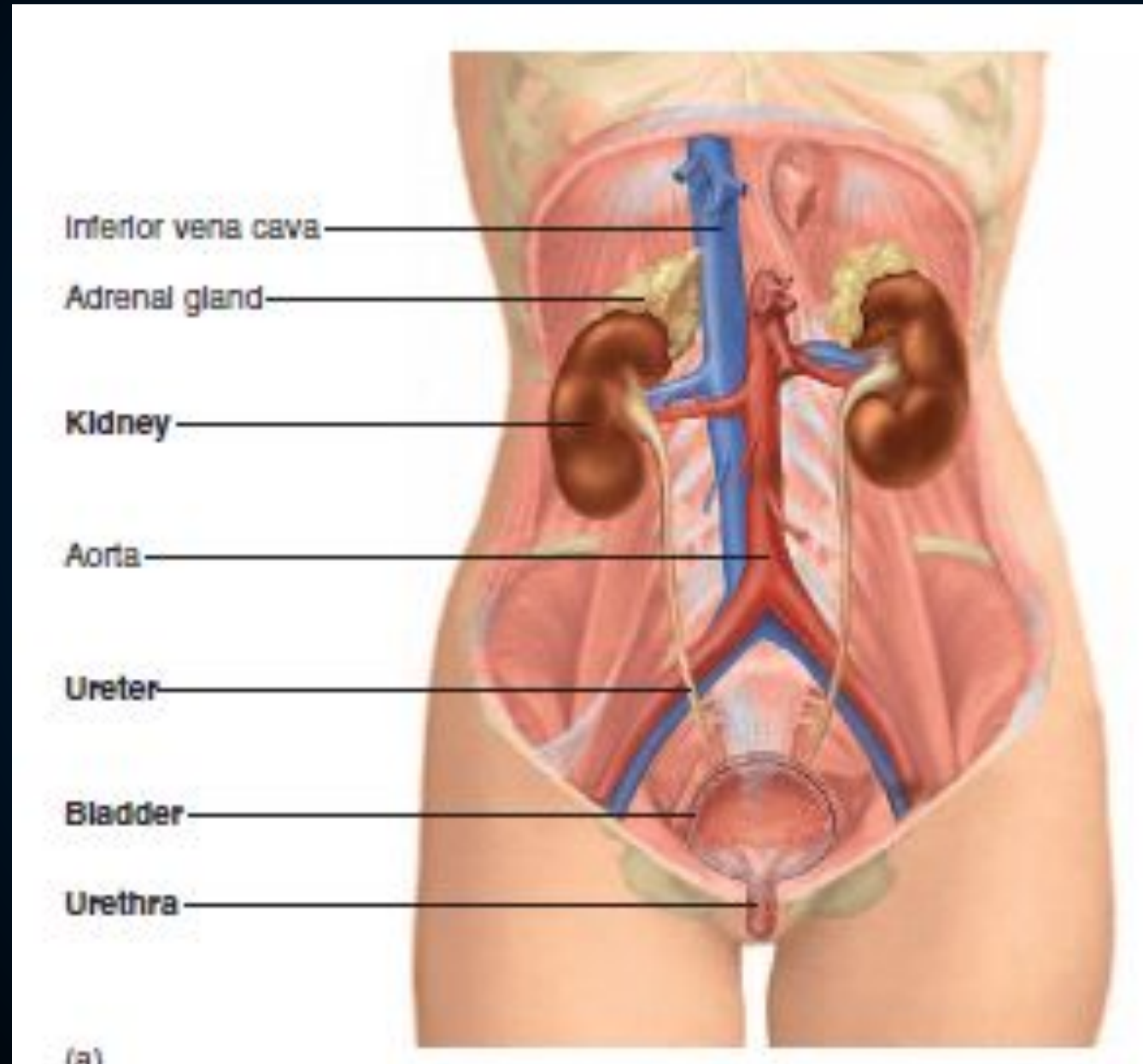
3 months



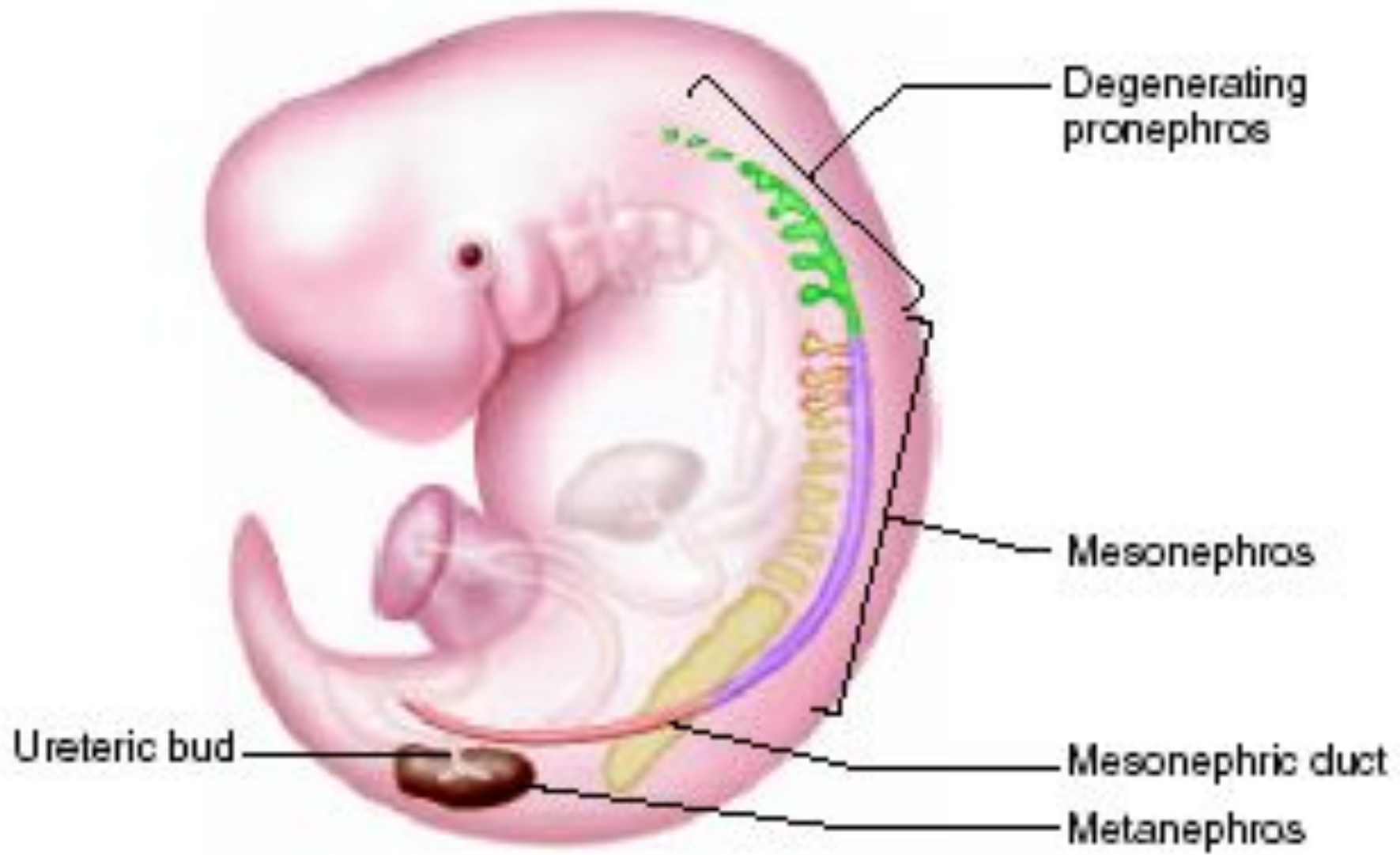
6 months

**FIGURE 23.15**  
Embryonic Development of the Respiratory System.

# Филогенез мочевыделительной системы хордовых



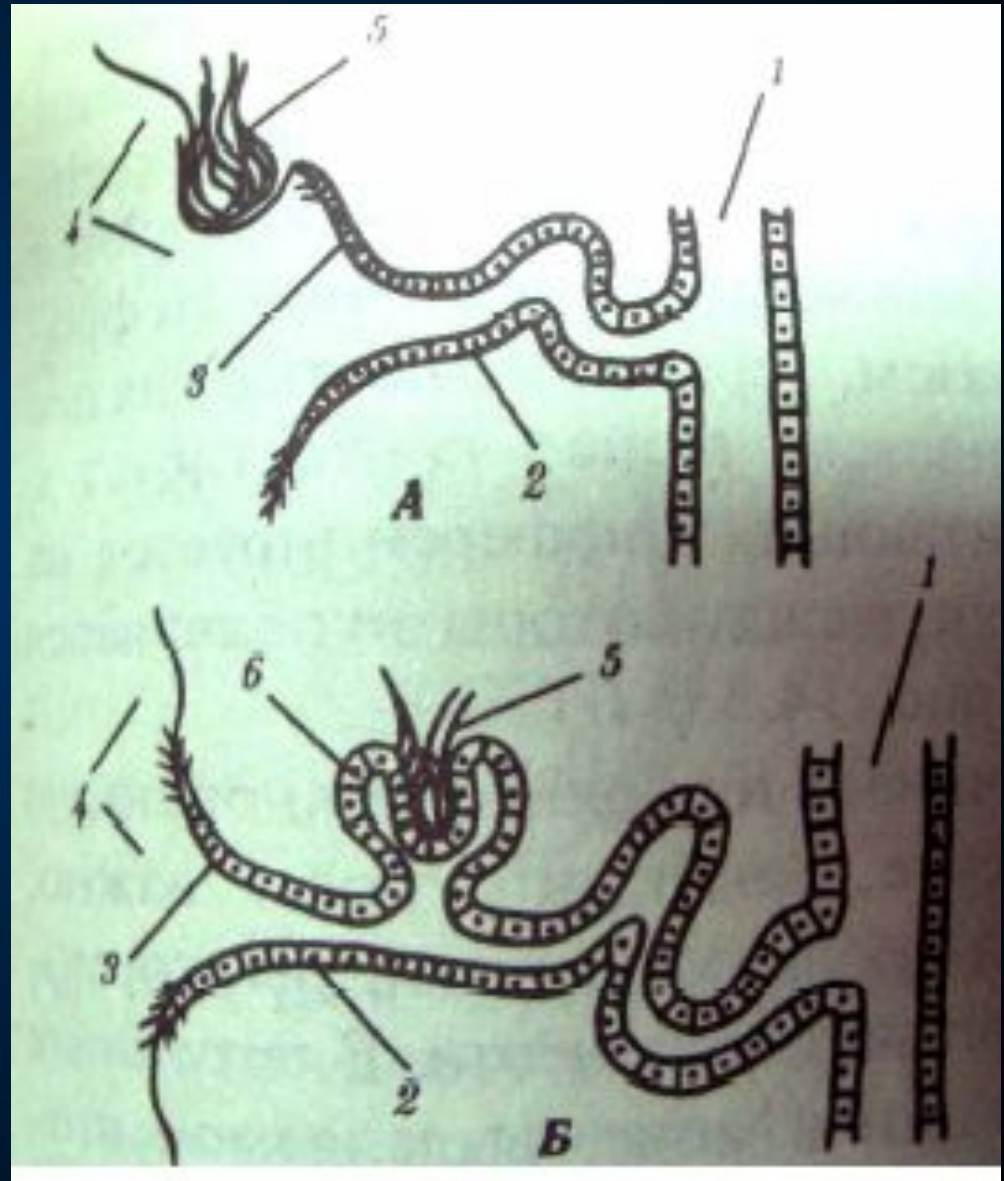
# Филогенез мочевыделительной системы хордовых



(a)

# Филогенез мочеполовой системы хордовых:

предпочка у рыб



первичная почка у  
земноводных

Freshwater fish

Food,  
fresh water

Gills:  
Active absorption of  
NaCl, water enters  
osmotically

Large  
glomerulus

NaCl

NaCl

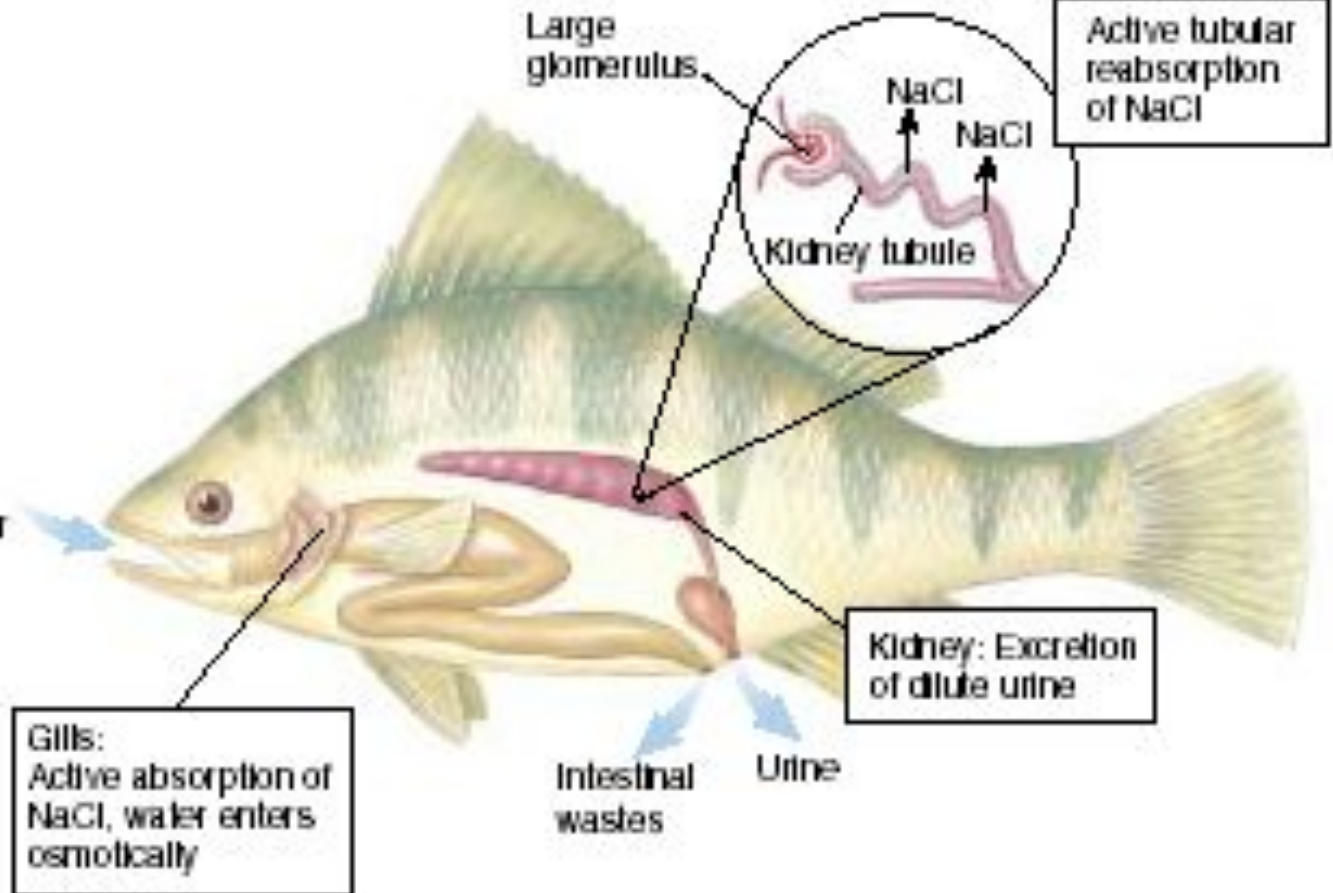
Kidney tubule

Active tubular  
reabsorption  
of NaCl

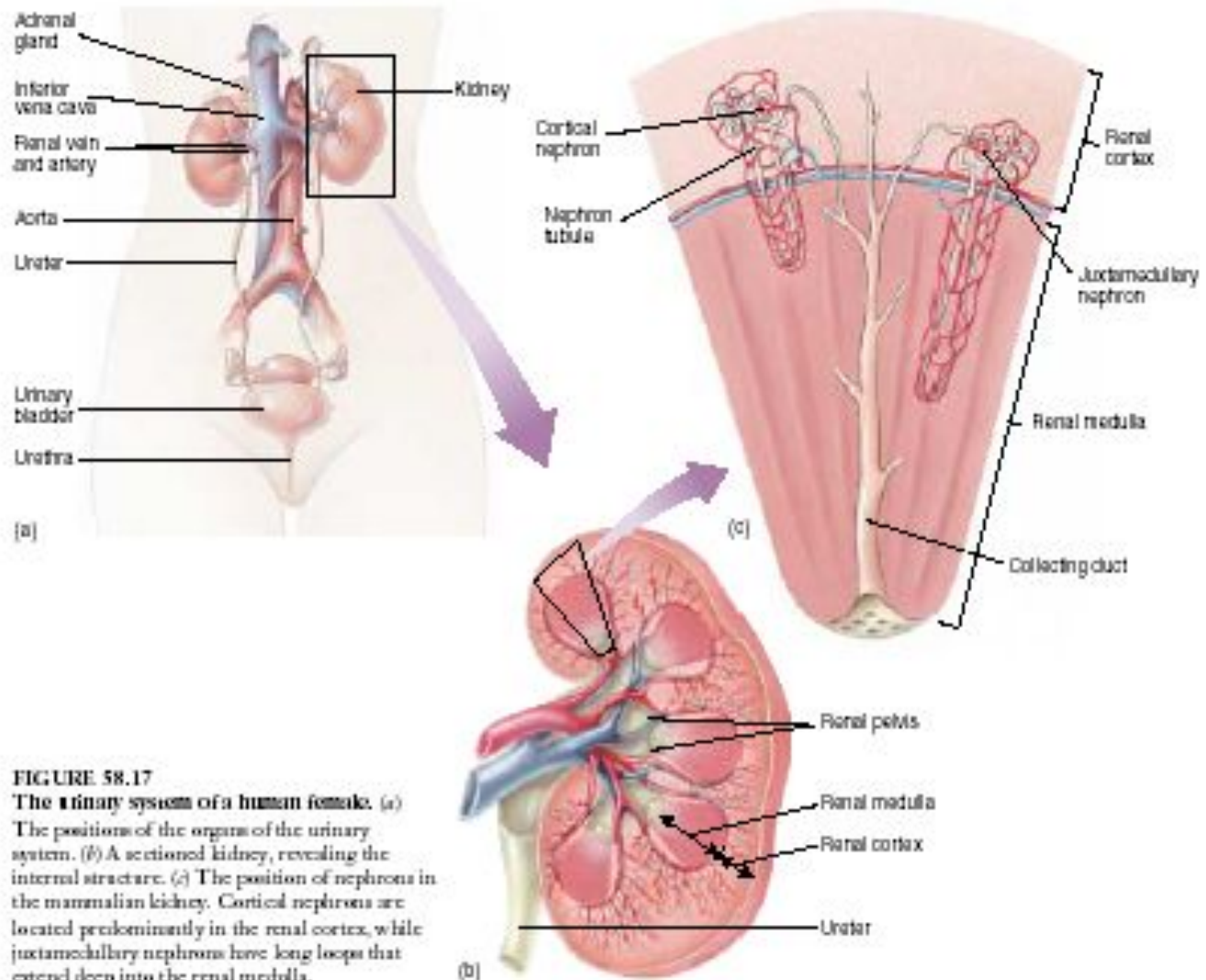
Kidney: Excretion  
of dilute urine

Intestinal  
wastes

Urine



# Филогенез мочеполовой системы хордовых: вторичная почка у млекопитающих

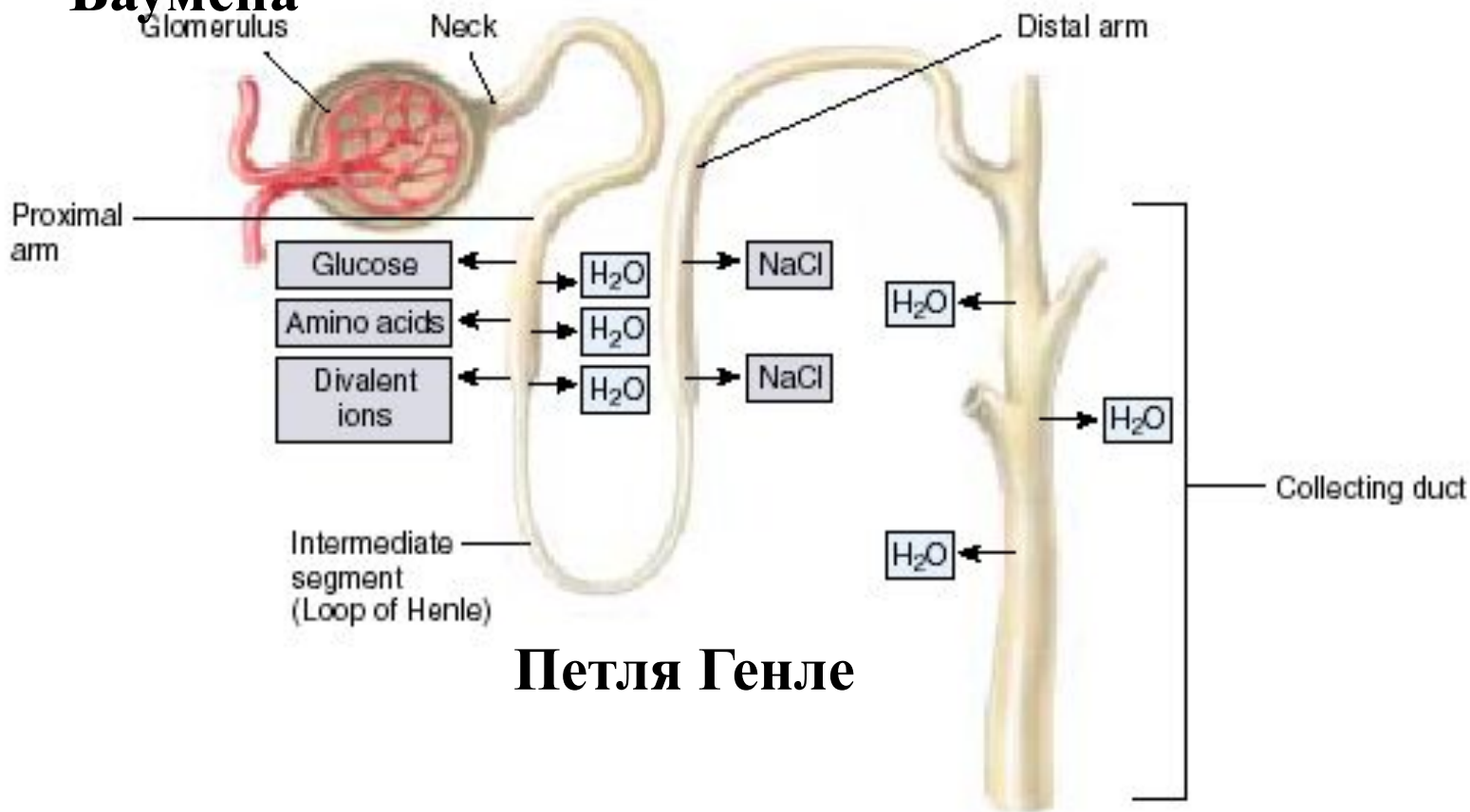


**FIGURE 58.17**  
The urinary system of a human female. (a) The positions of the organs of the urinary system. (b) A sectioned kidney, revealing the internal structure. (c) The position of nephrons in the mammalian kidney. Cortical nephrons are located predominantly in the renal cortex, while juxtamedullary nephrons have long loops that extend deep into the renal medulla.



# Филогенез мочеполовой системы хордовых:

## Капсула Шумлянского-Баумена

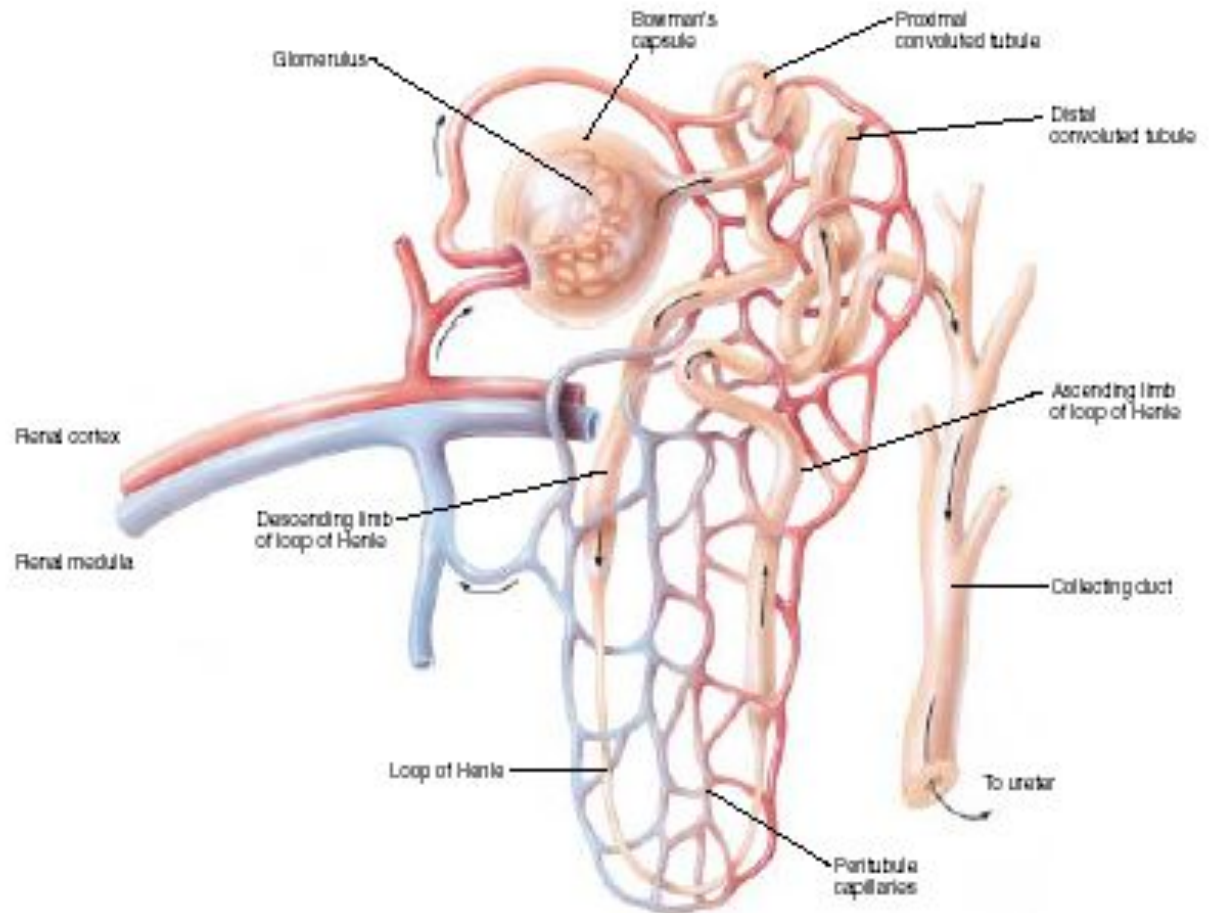


**основные структурные элементы нефрона**

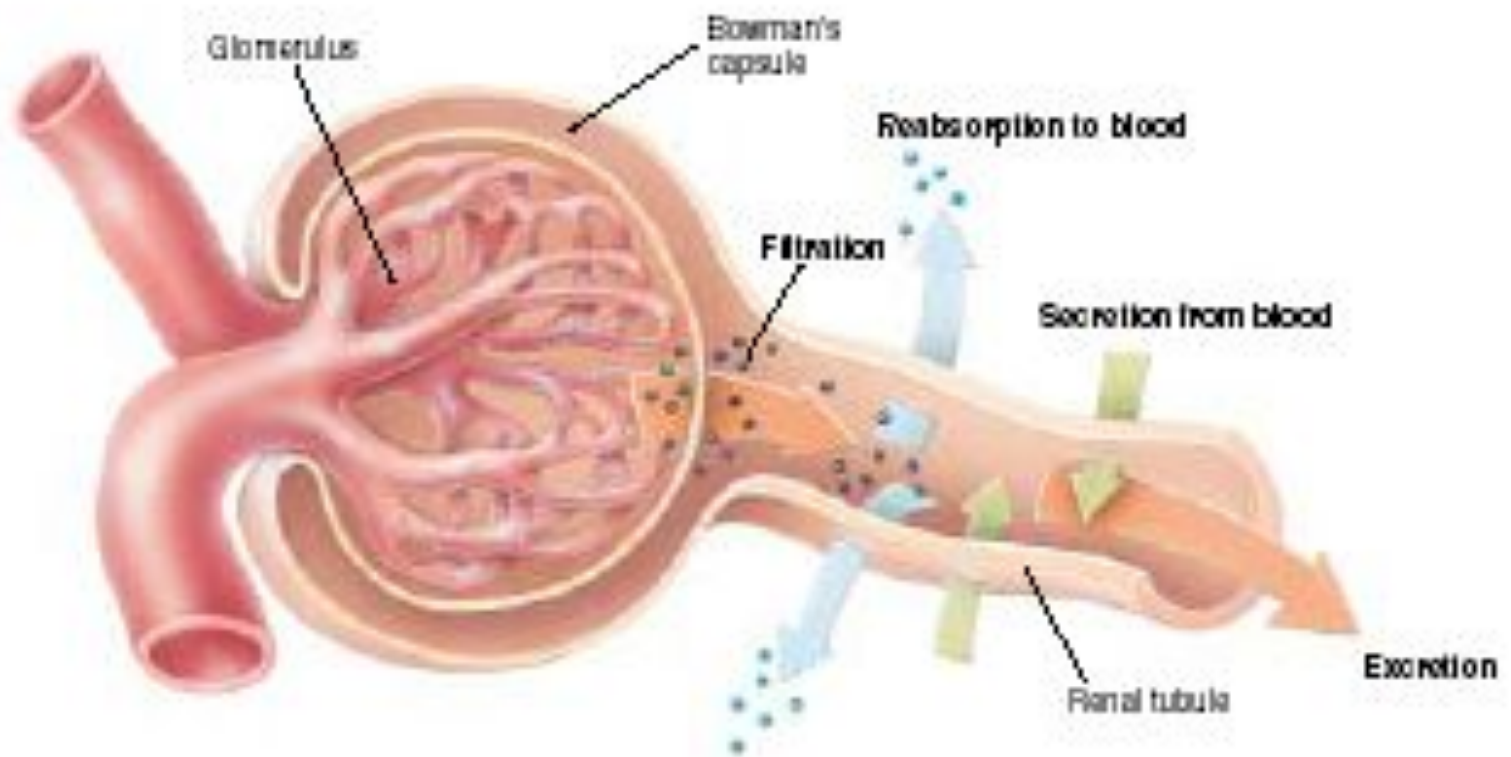
# Филогенез мочеполовой системы хордовых: вторичная почка у млекопитающих

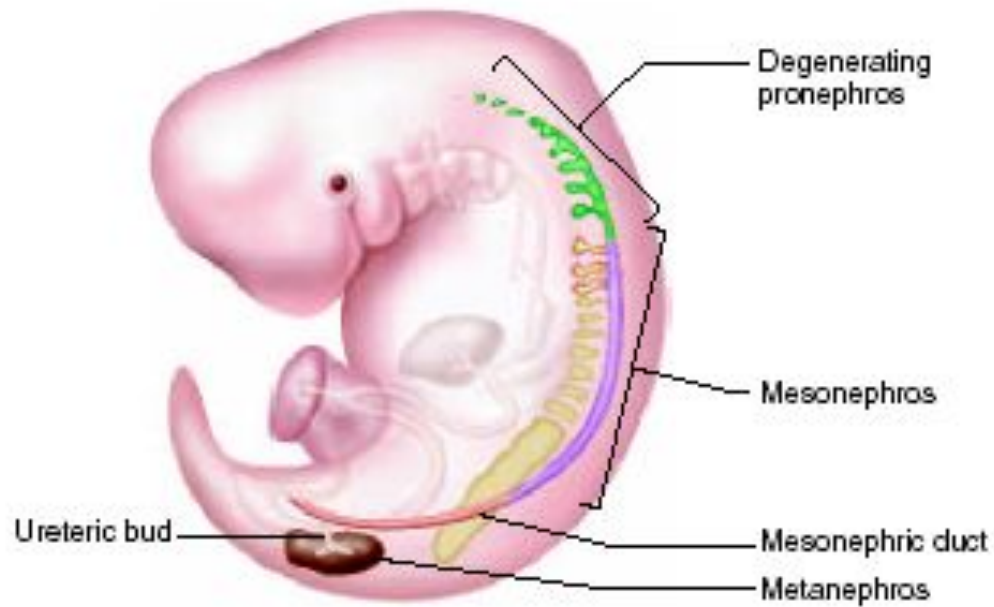
## Капсула Шумлянско-Баумена

## Петля Генле

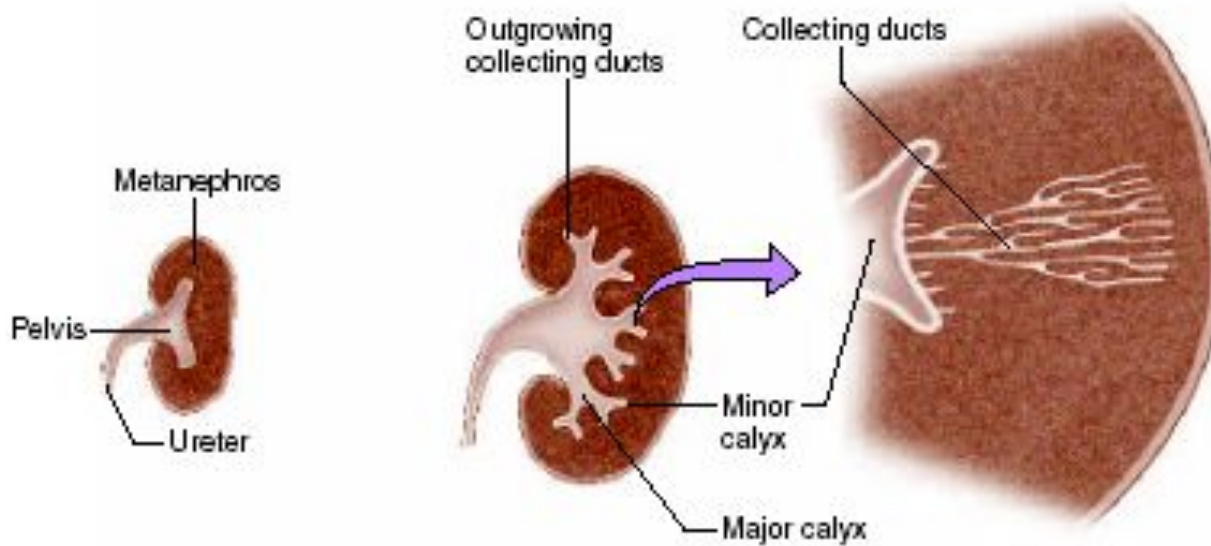


## Строение почечного тельца

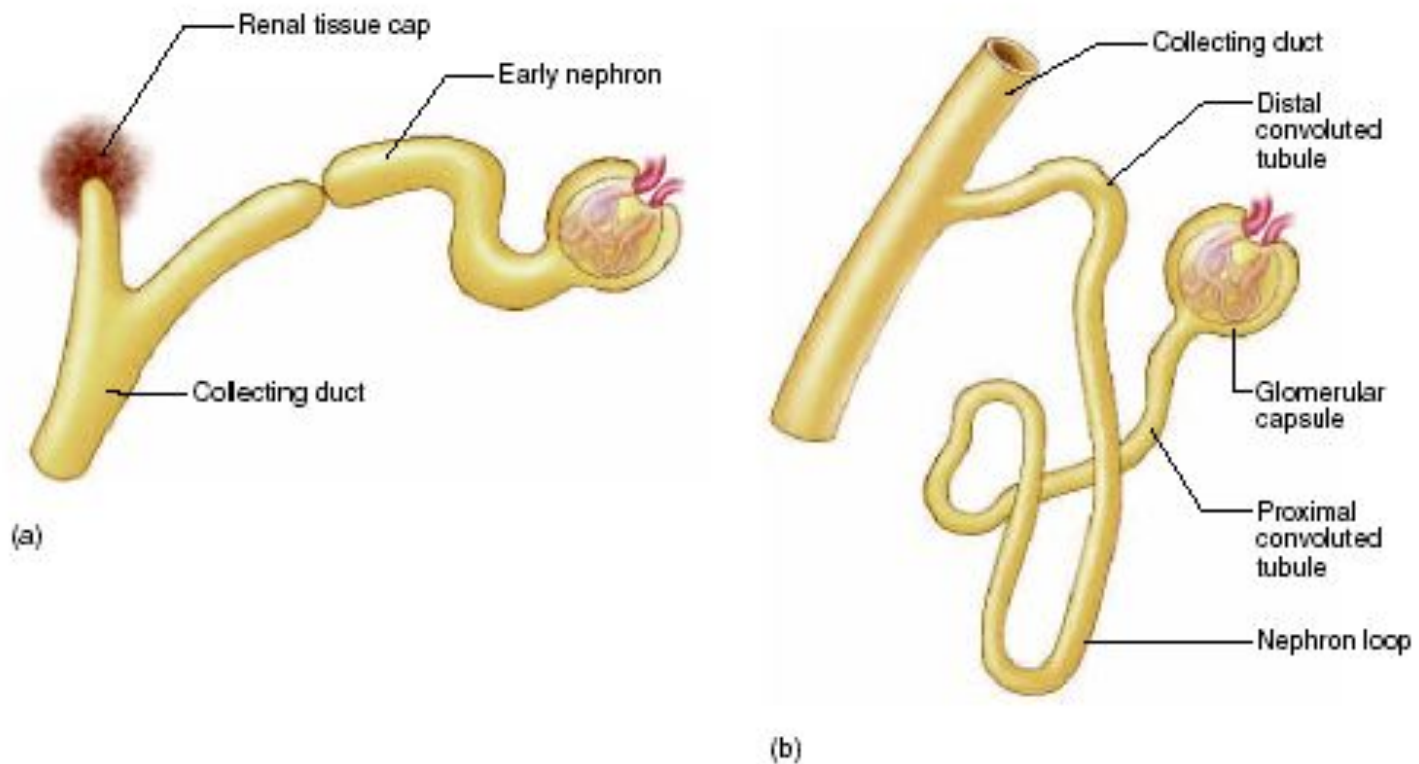




(a)



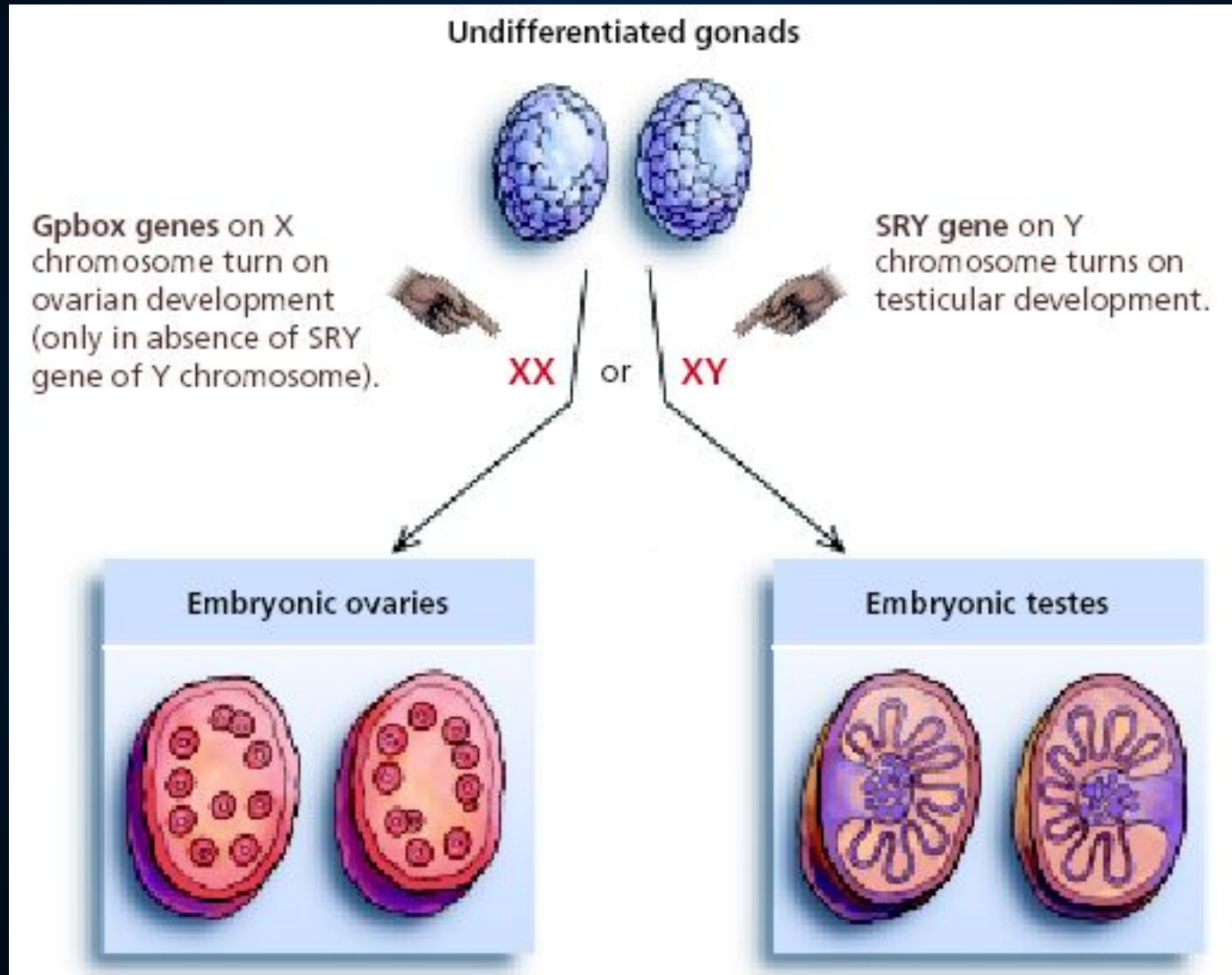
(b)



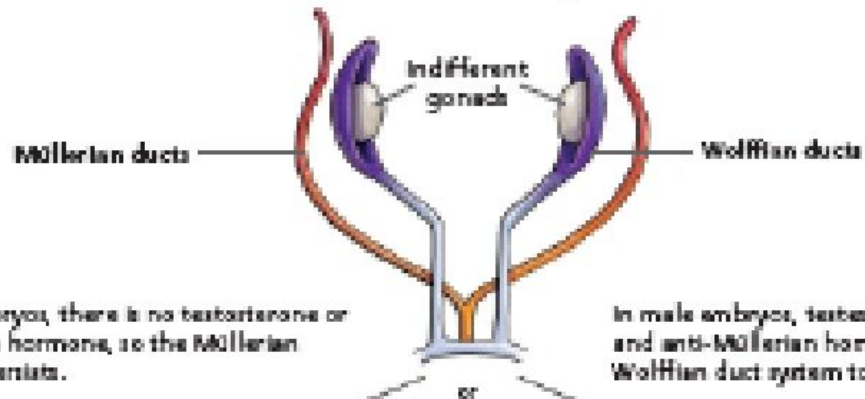
**FIGURE 25.12**

**Embryonic Development of the Nephron.** (a) The collecting duct induces mesoderm to differentiate into a renal (metanephric) tissue cap, as shown at the far left. This cap differentiates into an S-shaped tube that will become the nephron, as shown on the right fork of the duct (representing a later stage of development). (b) The renal tubule has begun to differentiate into proximal and distal convoluted tubules and nephron loop.

# Филогенез половой системы хордовых



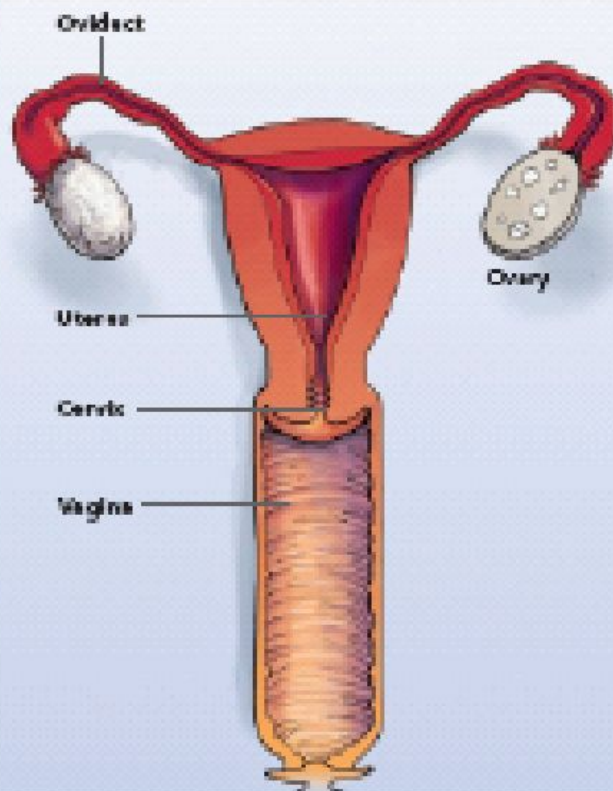
### Undifferentiated duct system



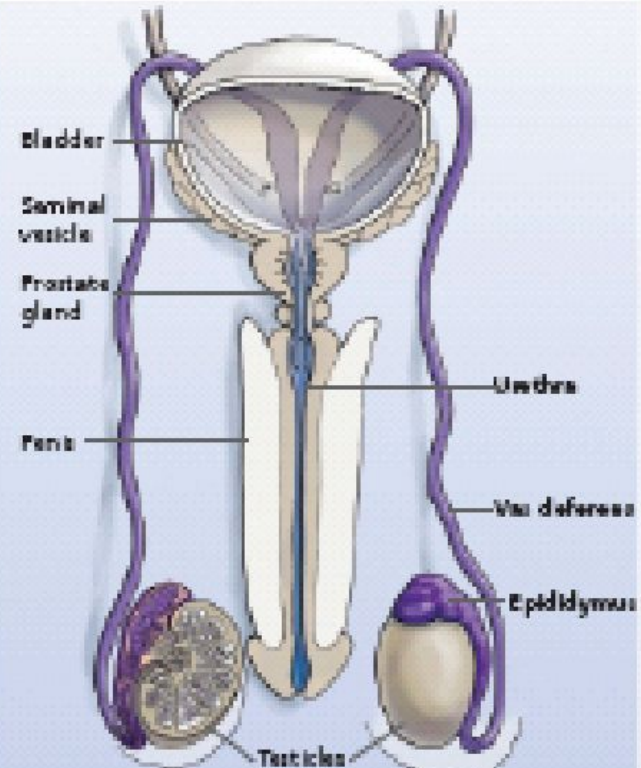
In female embryos, there is no testosterone or anti-Müllerian hormone, so the Müllerian duct system persists.

In male embryos, testes secrete testosterone and anti-Müllerian hormone that allow the Wolffian duct system to persist.

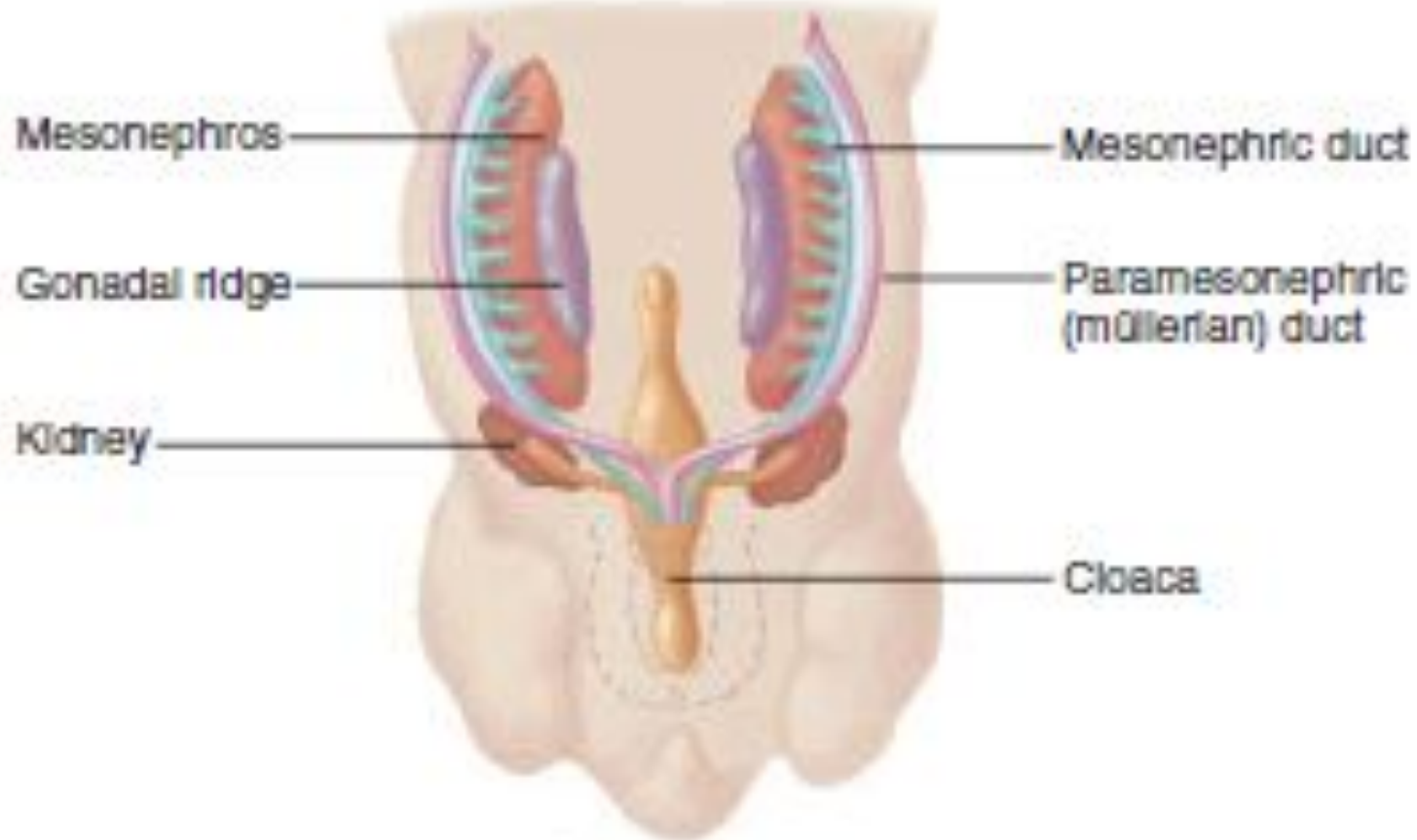
### Female duct system



### Male duct system

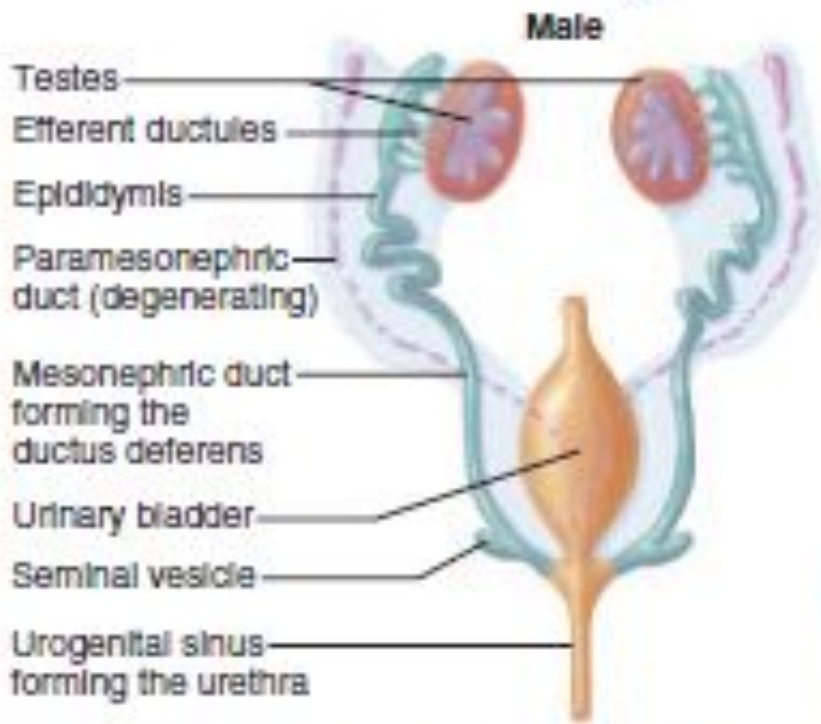


# Филогенез половой системы хордовых

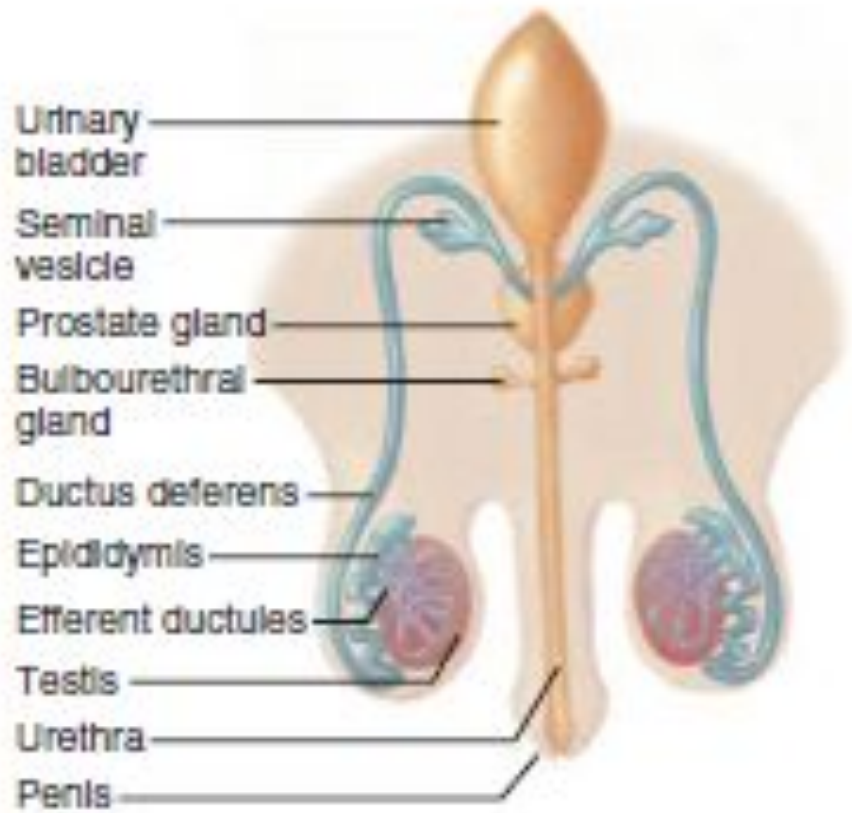


5- to 6-week embryo  
sexually indifferent stage

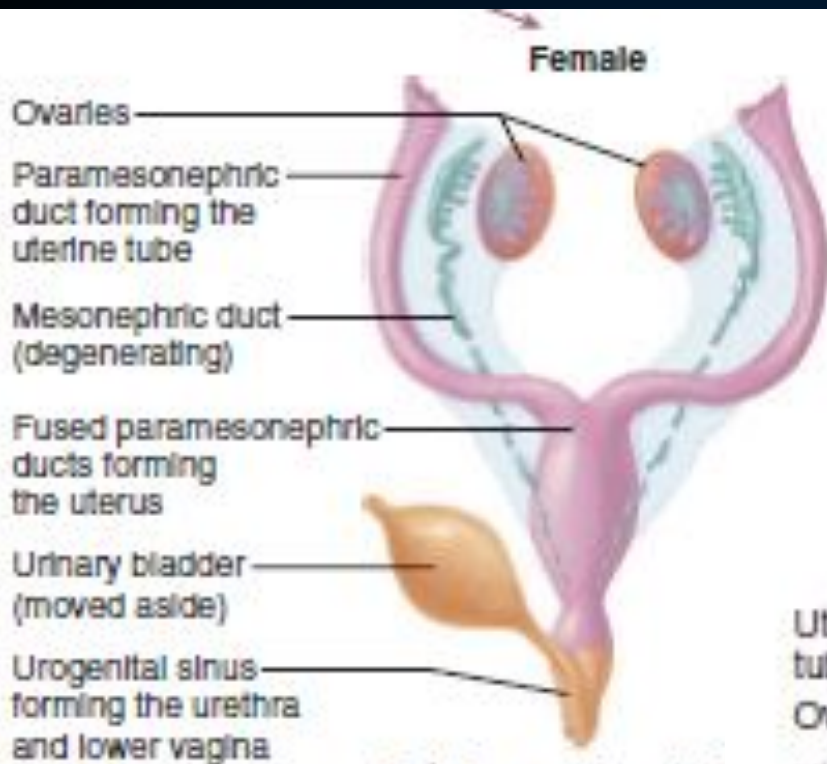




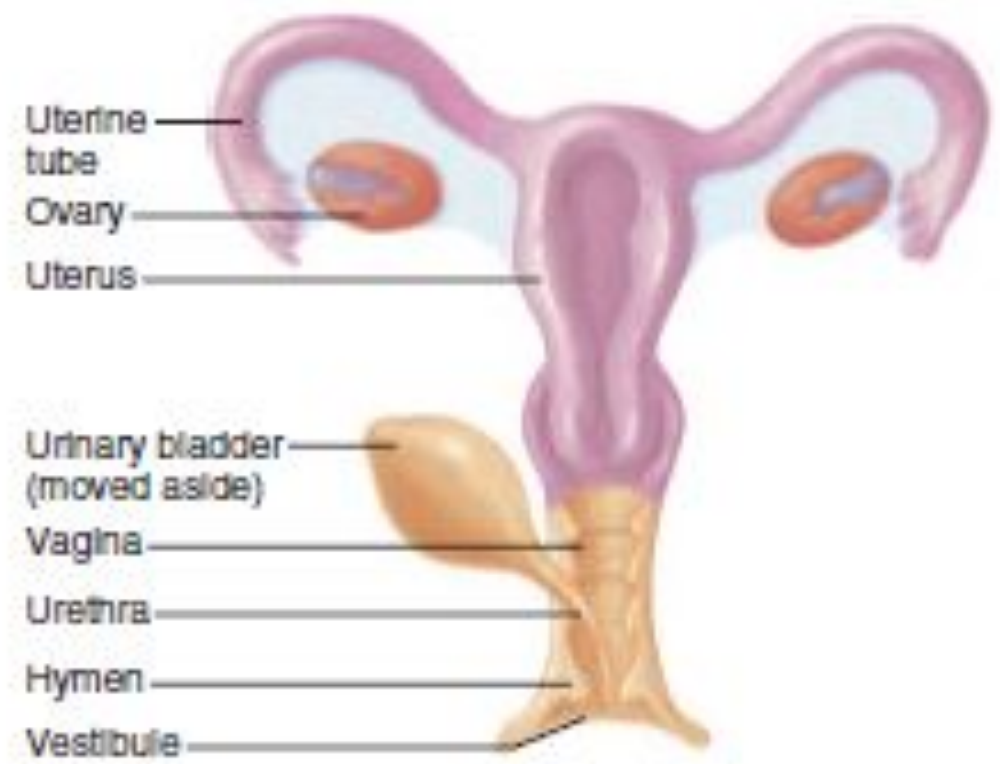
7- to 8-week male emb



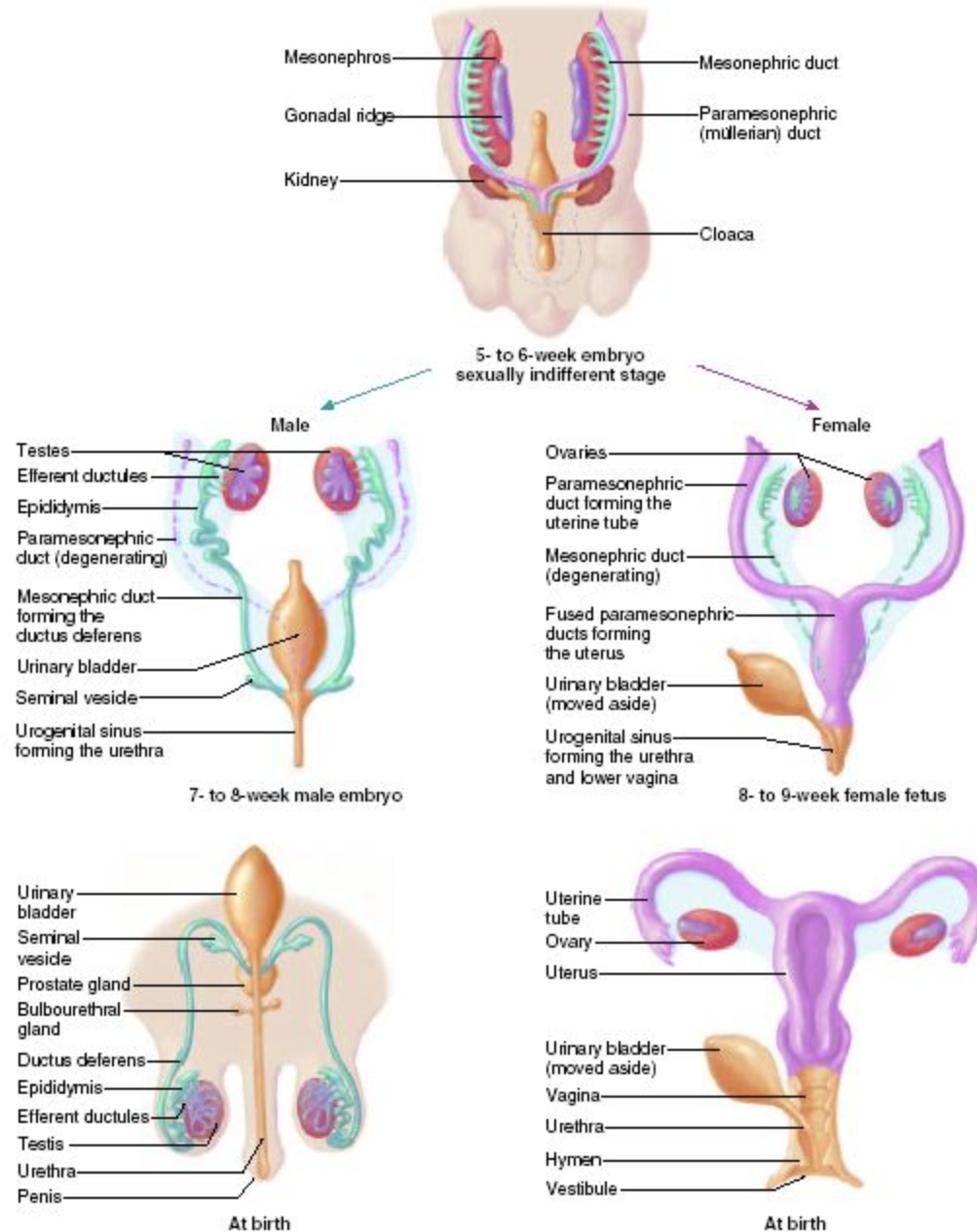
At birth



8- to 9-week female fetus



At birth



**FIGURE 26.26**

Embryonic Development of the Male and Female Reproductive Tracts. Note that the male tract develops from the mesonephric duct and the female tract from the paramesonephric duct, while the other duct in each sex degenerates.

# Онтофилогенетические предпосылки формирования врожденных пороков развития у человека

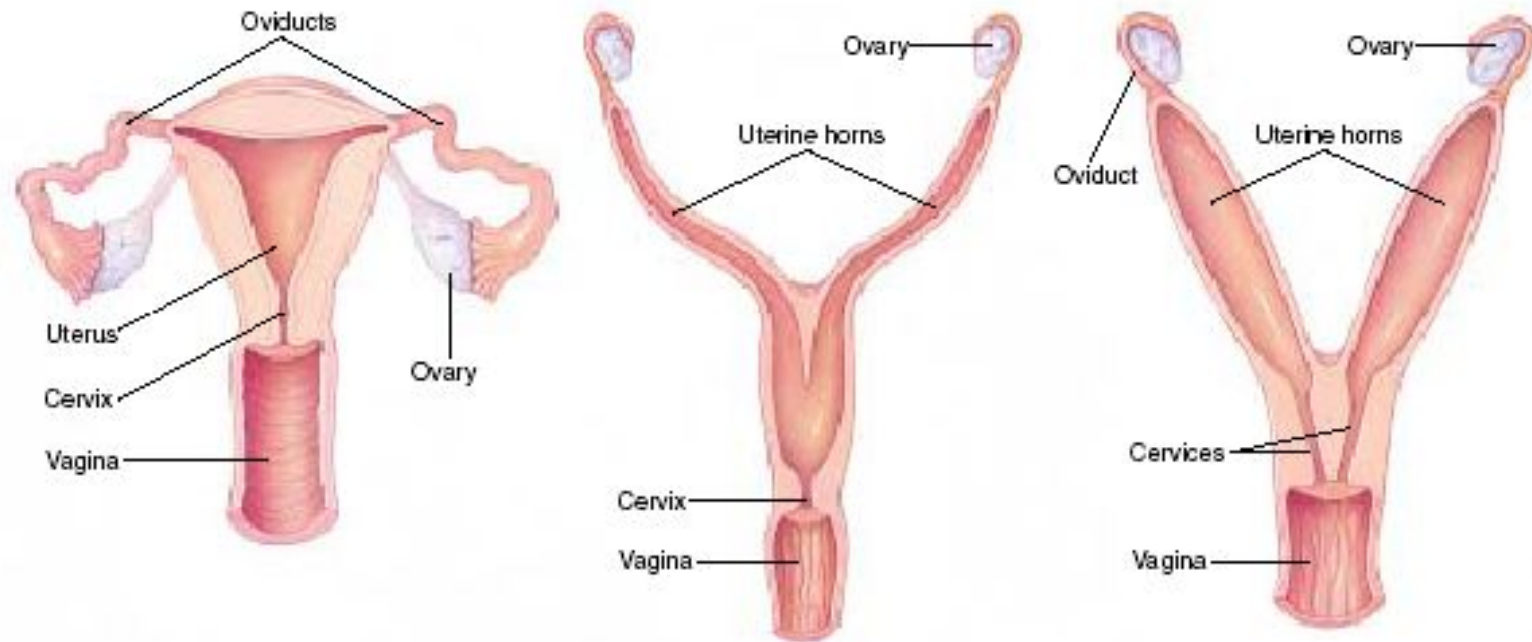


FIGURE 50.17